# FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

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Founder and Editor: STANLEY SPOONER

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**Oct. 1-23. Berlin Sporting Flying Exhibition.**
**Oct. 6. "Air Navigation." Lecture by Captain N. Macmillan, M.C., A.F.C., A.F.R.Ae.S., before R.Ae.S.**
**Oct 8-9. Chatham Air Display.**
**Oct. 18. Aero Golfing Society: Celion Challenge Cup, West Hill G.C.**
**Oct. 20. "Flying Conditions on the West Coast of Africa." Lecture by Flight-Lieut. W. G. Pudney, before R.Ae.S.**
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**Nov. 3. "Civil Primary Training." Lecture by Mr. H. G. Travers, D.S.C., before R.Ae.S.**
**Nov. 10. "Airscrew Design." Lecture by Mr. D. L. Hollis Williams, B.Sc., A.F.R.Ae.S., before R.Ae.S.**
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**Nov. 24. "The Evolution of Aircraft Wireless Equipment." Lecture by Squadron Leader H. Leedham, O.B.E., R.A.F., before R.Ae.S.**
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**Dec. 1. "The Behaviour of Fluids in Turbulent Motion." Lecture by Mr. A. Fage, A.R.C.Sc., F.R.Ae.S., before R.Ae.S.**
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### IMPORTANT NOTICE

Commencing with next week's issue of FLIGHT, the day of publication will be advanced one day, viz.: from Thursday to Wednesday each week in order that (owing to the increasing foreign circulation) the mails for abroad can be caught regularly.

At times it has unfortunately happened that some of these have been missed and thus delivery delayed to our foreign subscribers.

**Editorial Matter.**—It should be noted that all editorial matter for the future therefore **must** reach the Editor not later than the first post every Monday morning.

**Advertisements.**—All advertisement copy must be received by the **previous Friday morning,** to ensure proper attention.

**All** communications should be addressed to 36, Great Queen Street, Kingsway, London, W.C.2.

# EDITORIAL COMMENT

YET another world's record has been achieved by Great Britain. By his flight on September 16 Mr. Cyril F. Uwins, Chief Test Pilot of the Bristol Aeroplane Co., Ltd., raised the world's altitude record for heavier-than-air craft to 13,404 metres (43,976 ft.), thus beating the previous record, held by the United States of America, of 13,157 metres (43,181 ft.) by 247 metres. The stipulation is that an altitude record must, to be recognised by the F.A.I., exceed the existing record by 200 metres (656 ft.).

**The Altitude Record**

In our opinion the great merit of the British world's record is that it was established with flying material all but standard, and not specially designed for the attempt. Here was no engine supplied with fuel by superchargers in series; no airtight cabin to protect the pilot; no special gear-box or variable-pitch propeller to aid the machine in getting off before the supercharger could be brought into use. The aircraft was, if not a standard service type, at any rate so little changed from its normal form as to be a practical aeroplane for many service

purposes quite apart from breaking altitude records. The Vickers "Vespa" was designed as an Army co-operation machine, and as it was produced with Bolivian conditions in view (the aerodrome at Le Paz being situated at about 13,000 ft. above sea level) it was given a very large wing span (50 ft.). The result is that the induced drag is low, and, as induced drag plays a very important part at climbing speeds, and when an aircraft is nearing its ceiling, the "Vespa" happened to be particularly suitable for the purpose of breaking altitude records. The Bristol Aeroplane Company installed the "Pegasus" engine (the standard "Vespa" is fitted with the "Jupiter"), and generally "cleaned up" the machine for the flight. A Boulton & Paul Townend ring was fitted over the engine, and doubtless helped materially in reducing drag. The front cockpit was covered over, and the machine was flown by Uwins from the back seat. Otherwise the "Vespa" was not altered materially.

The Bristol "Pegasus" engines were introduced early this year to meet modern requirements, and the series includes unsupercharged, moderately supercharged, and fully supercharged types. In addition, two airscrew gear ratios are provided, with ratios of 0·655 : 1 and 0·5 : 1 respectively. The "Pegasus" used by Uwins was a perfectly standard engine with two exceptions: the compression ratio (normally 5·3 : 1) was raised slightly, and the diameter of the impeller of the supercharger was increased one inch in diameter. Otherwise the engine was standard.

While fully appreciating the value of the work being done abroad on aircraft and engines for penetrating into the stratosphere, we think the newly-established British world's record is of greater immediate practical value. The experience gained by the Bristol company of the effects of contraction and expansion with large changes in temperature, the problems of fuel, oil, ignition, carburation, cooling, etc., and the effectiveness of the supercharger, all these can be applied at once to the improvement of existing service types of aircraft and engines. Thus, quite apart from the undoubted value of holding a world's record, immediate benefits of a technical nature may be expected from the series of researches carried out by the Bristol Aeroplane Company, which culminated on September 16 in the establishing of a world's record.

In our admiration of the technical qualities of the material which made the record possible, we should not forget to extend due appreciation to the human element, in the form of Mr. Uwins, who, his disclaimers notwithstanding, played in the successful attempt the most important part of all. There are probably not many pilots in the country who would greatly care for the task of taking an aircraft up to such heights. Admitting that by a series of flights, each going a little higher than the previous, he felt his way gradually and found out that he suffered no physical discomforts, Uwins was still exposing himself to very considerable risks. Hydrogen apparatus is, like all other mechanical contrivances, fallible. Had this apparatus failed him he would have been in a serious plight. Uwins himself insists upon looking at the record flight as merely one of a long series which took him a few thousand feet higher than before. The modesty which has kept him out of the limelight, which is quite natural to him and which is perfectly sincere, cannot, however, prevent other people from seeing in his flight a very fine piece of piloting, and can but increase the esteem in which Uwins was already held by all who have the privilege of knowing him.

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**The Prince Flies to Denmark**

Once again the Prince of Wales is acting as the trade ambassador of Great Britain by his visit to Copenhagen, there to open the Anglo-Danish Exhibition ; and once more he has chosen the aeroplane as his means of travel. It was in many ways a pity that he could not use *Atalanta*, the new A.W.15, which has been designed for the Cairo-Capetown section of the African airway ; but his appearance over the capital of Denmark in the huge *Heracles* has without doubt made a great impression on the people of the city. The Danes are no strangers to British aircraft, and the Prime Minister, Herr Staunding, emphasised in his speech at the opening of the exhibition that British engineers had designed most of the Danish aeroplanes. The Prince in his opening speech commented on the British aeronautical exhibits in the exhibition, and as we go to press reports have come from Copenhagen that the Danish Government is taking more than a casual interest in these exhibits, and that more may be heard of this matter before very long. To mention only one of the British exhibits, we feel sure that no engineer could examine the specimen of the Rolls-Royce "Kestrel" and study its performance without being very much impressed.

In these days of tariffs it is very refreshing to see an exhibition opened in a foreign country for the expressed purpose of encouraging British imports. At the same time, we British never quite look on the Danes as foreigners. Between the Thames and the Forth, and in fact all up our east coast to Aberdeen, the blood of our people is very largely Danish, and that old link was re-forged when the late Queen Alexandra came from Denmark to be the best-loved Queen Consort that Great Britain has ever known. Our King is half Danish by blood, and the two Heirs-Apparent who are now in Copenhagen are second cousins.

In commerce, sentiment and self-interest must work hand in hand. If trade relations are based merely on cousinship, they may lead to anything but mutual profit. In this case the commerce between the two countries is of mutual advantage. The dairy produce of Denmark is very popular in this country, but there must have been a distinct feeling of apprehension that British imports might be affected by the "Buy British" movement. If the Danes buy more British products, there will be a very sound reason for us to persist in our consumption of the very excellent Danish rashers and butter pats before we embark upon the labours of the day.

# THE PRINCE FLIES TO DENMARK

H.R.H. the Prince of Wales flew from Croydon to Copenhagen on Thursday, September 22, to open the Anglo-Danish Exhibition there. It had first been intended that he should use the *Atalanta*, the first of the four-engined Armstrong-Whitworth machines designed for the Cairo-Capetown section of the African airway, and it would have been a fine demonstration if this new type could have made its first useful flight on such an occasion and with such a passenger. Unfortunately *Atalanta* was not quite ready. Her wireless needed some final adjustments, which could not be made in time, and so, though she was flying at Croydon that morning, and her sister *Amalthea* was also in the sheds of Imperial Airways, it was decided to send the Prince off in *Heracles*, one of the Handley Page type 42 machines. The start was timed for 9.30 a.m. The Prince flew up from Sunningdale in a three-engined Spartan "Cruiser." He was met by his Comptroller, Admiral Sir Lionel Halsey, and by a representative of the Secretary of State for Air. There was little delay, and the Prince at once embarked on *Heracles*, accompanied by Sir Godfrey Thomas and Lieut. Col. Piers Legh. The pilot was Mr. Youell. At 9.40 the machine took off and headed for Amsterdam. On reaching the coast two "Southampton" flying boats took up position as escort, and flew with the Handley Page to the coast of the continent.

The weather was fine when *Heracles* left Croydon, but bad weather was soon encountered, and the machine was nearly 40 minutes late in arriving at Schipol aerodrome, Amsterdam. Another landing was made at Hamburg; and Kastrup aerodrome, Copenhagen, was reached about 6.30 p.m. *Heracles* was escorted in by 26 Danish aeroplanes. The Prince of Wales, who was greeted by the Crown Prince of Denmark (his cousin) and other members of the Danish Royal Family, as well as by the British Minister, received a great reception from the people of Copenhagen.

On Saturday, the 24th, when the Prince opened the Exhibition, in the course of his speech he said:—

"I am glad to say that British motoring and British aviation are well represented, not only because I have a personal experience of our progress in these directions, but because I feel that the nation which holds nearly all the world's speed records on land and water and in the air is entitled to remind the world of these achievements. It is equally encouraging that British engineering, which has enjoyed so high a reputation for the past 100 years, is also prominent."

The Danish Prime Minister, Herr Staunding, in his speech made the following remarks:—

(FLIGHT *Photos.*)


**AT CROYDON: In the top picture the Prince is seen de-planing from the Spartan "Cruiser"—in which he flew from Sunningdale—and below he is walking to the *Heracles* with Admiral Sir Lionel Halsey. The bottom picture shows the *Heracles* (with the Spartan "Cruiser") just before the start for Denmark.**

**IN DENMARK : The Prince of Wales (right) walking with the King (left) and Queen of Denmark through the grounds of the British Exhibition, which he opened at Copenhagen. The Crown Prince of Denmark, his co-patron, is seen behind and to the right of the Queen.**

"It was from Great Britain that the Danes had got their first steamship. British engineers had made most of the Danish railways, and designed most of the Danish aeroplanes. British engineers built most of the Danish gasworks, and it was from Great Britain that Denmark had just brought the gigantic machinery for her latest electricity works."

Among the British aero exhibits at the Exhibition are a Rolls Royce "Kestrel" sectioned model. The Armstrong-Siddeley firm is also showing engines, and Vickers Aviation are showing accessories and models. We hope to publish a full list of British aero exhibits in due course. The Danish Government are taking a special interest in the British aeronautical exhibits.

# WORLD'S ALTITUDE RECORD FOR BRITAIN

WHEN we went to press with last week's issue of FLIGHT it was not quite certain what precise figure the National Physical Laboratory would assign to the barograph chart obtained during Mr. Uwins' altitude flight in the Vickers "Vespa" fitted with the Bristol "Pegasus" supercharged engine on September 16. The chart has now been carefully examined and checked by the N.P.L., and the official reading gives 13,404 metres (43,976 ft.) as the altitude registered. As this beats the existing world's altitude (held by the United States of America) by a sufficient margin, the flight will be submitted by the Royal Aero Club of the United Kingdom to the *Fédération Aéronautique Internationale* for homologation as a world's record.

Mr. Uwins, Vickers (Aviation), Ltd., and the Bristol Aeroplane Co., Ltd., are to be congratulated upon this outstanding success, which has once more called attention to the qualities of British aircraft material. Vickers (Aviation), Ltd., in particular may well feel proud of having had one of their aircraft add the world's altitude record to the world's speed record already held by the Vickers Supermarine S.6 monoplane (407.5 m.p.h.).

On Friday of last week we were invited to Filton to see the machine and engine, and to have a chat with Mr. Uwins about his remarkable flight. Mr. Roy Fedden, who designed the new "Pegasus" engines, explained to those present something of the problems that had to be solved before the record flight could be accomplished. The flight was, he said, the culmination of a prolonger period of research work on supercharging carried out by the Bristol Aeroplane Company's engine department.

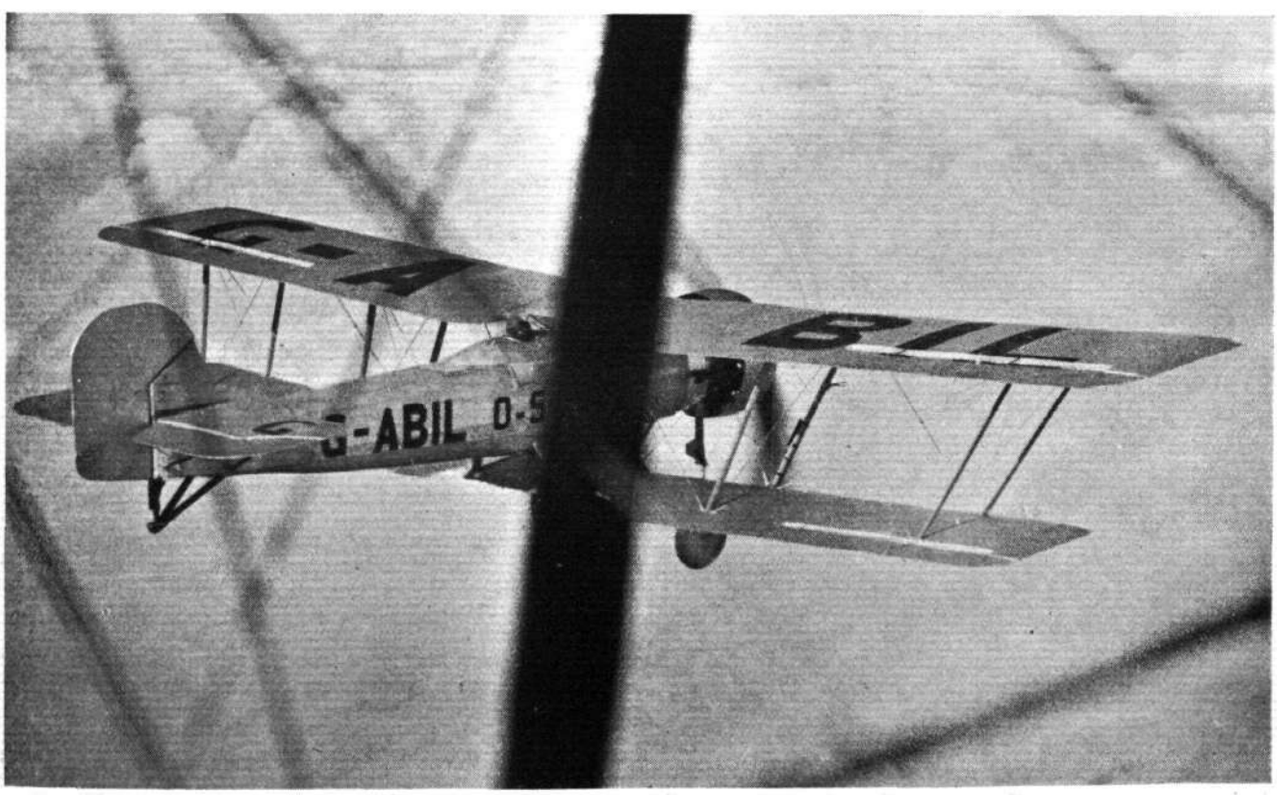
**SITTING ON TOP OF THE WORLD : Mr. C. F. Uwins "doubling" for Mr. C. F. Uwins to give the camera people an idea of what he looked like when he looked down on this vale of tears from about 44,000 ft.**
(FLIGHT *Photo.*)


**" PER ARDUA AD ASTRA " : The Vickers " Vespa " (Bristol " Pegasus ") on the way towards 44,000 ft.** (FLIGHT *Photo.*)

and the supercharger was the result of close collaboration between the Bristol Company and the Royal Aircraft Establishment at Farnborough. Mr. Fedden pointed out that the engine was a standard " Pegasus," series S.3, with the exception that the compression ratio had been raised somewhat and the diameter of the impeller of the supercharger had been increased by 1 in.

At full engine speed and full supercharge, the impeller was running at 23,000 r.p.m., and it will readily be appreciated that the workmanship must be of the very highest order if smooth running is to be achieved. We were privileged to examine one of the superchargers in Mr. Fedden's office, and a very beautiful piece of work it is. The drive incorporates not only a spring device, but also friction clutches, so that if the engine is opened out suddenly, the impeller of the supercharger is protected from too sudden acceleration. Mr. Fedden was warm in his praise of the people who had collaborated with him in the research work, such as the petrol company in producing a special " BP " fuel, Ransome & Marles in work on bearings, the B.T.H. Company in producing magnetos with a specially wide safety spark gap (the dielectric qualities of the air being greatly decreased at the tremendous height attained) and K.L.G. Plugs in similarly producing plugs giving a long external path to prevent shorting.

To illustrate the sort of problems one is facing in reaching very great heights, Mr. Fedden pointed out that if one takes a naturally-aspirated engine of 100 b.h.p. at ground level, that engine will only give about 50 b.h.p. at 18,000 ft., and only about 15 b.h.p. at 40,000 ft. The supercharger of the " Pegasus " came into use at 11,000 ft., and the pressure produced by it was approximately 1.8 atmospheres. At the ceiling reached by Uwins, the power had dropped to about 170 b.h.p., and it is interesting to note that the " Vespa " was able to fly at 44,000 ft. for

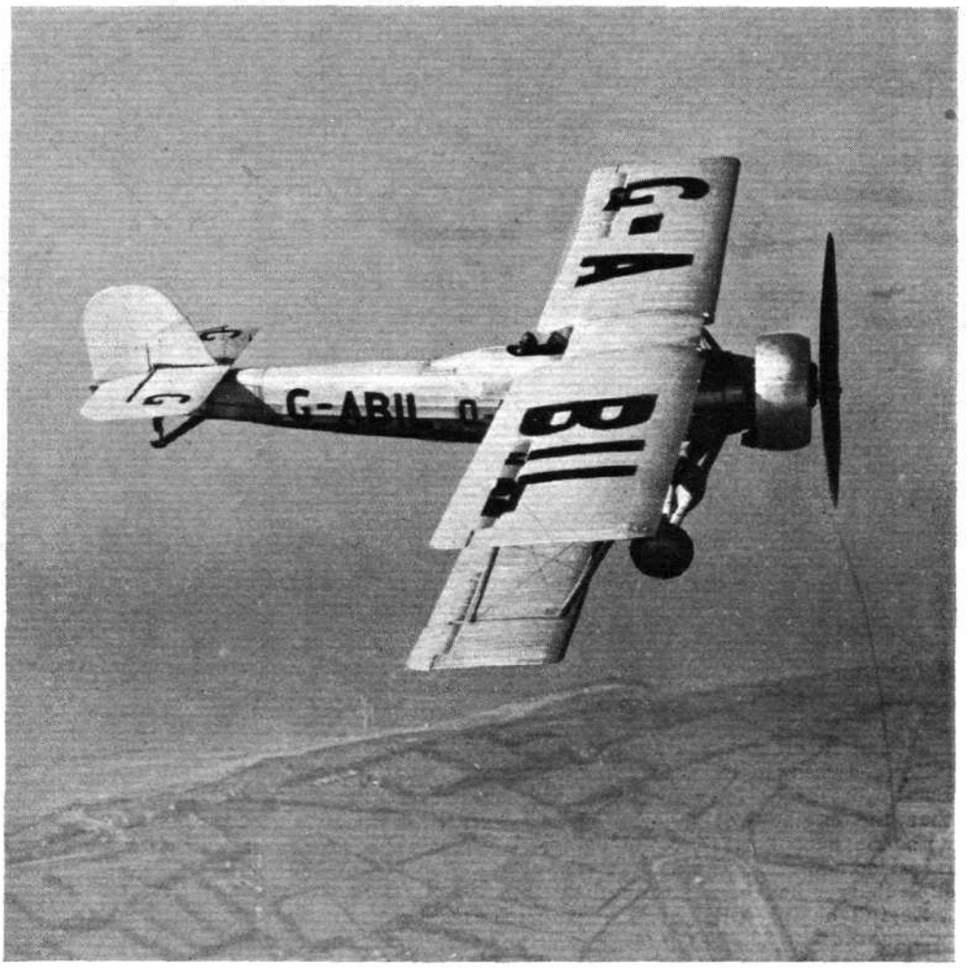



**" SPAN SQUARE OVER W " : The Vickers " Vespa " (Bristol " Pegasus ") is characterised by large span and, consequently, low span loading.** (FLIGHT *Photo.*)

such a low expenditure of power. At ground level the minimum power required by the machine would probably be even slightly less than this, owing to the fact that the machine would then likely be flying at a rather better part of its L/D curve.

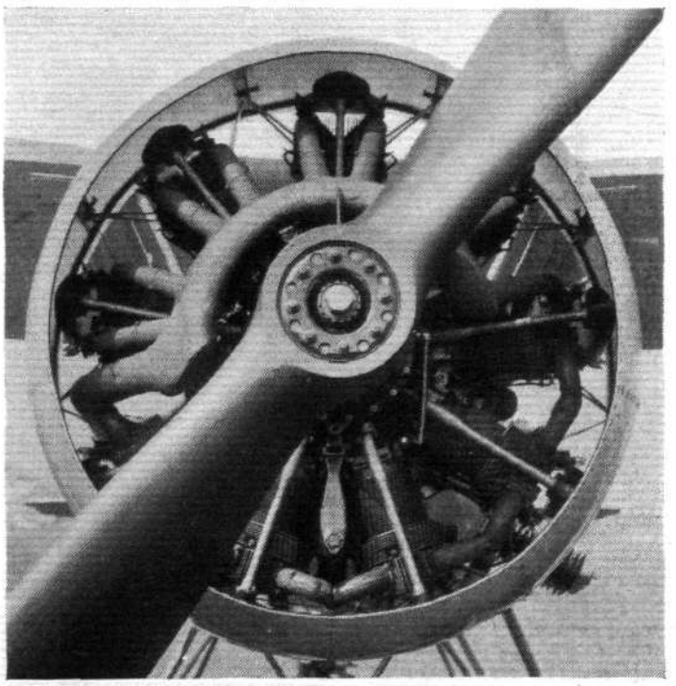
Mr. Fedden also paid a tribute to the Vickers Company for having placed the "Vespa" at his disposal. With its large span that machine was particularly suitable for the work. Some slight modifications to it had been made in the Bristol shops, including shifting the pilot to the rear seat to avoid having to carry ballast. The view from there is not too good, but in spite of this Uwins managed to make perfect landings on all his test flights. Mr. Fedden particularly expressed his satisfaction with the fact that the world's record had been established on an aircraft which was in service use, and which was fitted with an engine also in production and being used by the R.A.F. They had, he said, learnt much from their experience with the record machine and engine, knowledge which could be instantly used and applied to service and civil aircraft types.

Mr. Rex Pierson, Chief Designer of Vickers, recalled that the actual "Vespa" used by Uwins was flying as long ago as 1927. Machines of the same type had been delivered to, and were used by the Bolivian Air Force and the Irish Free State. Last year the actual machine was in China, and in point of fact was marooned on Nankin Aerodrome. However, it was rescued, and Capt. Barnwell, Bristol's Chief Designer, had had the task of doing the engine installation and generally getting the machine in trim for the flight. He (Pierson) had nothing whatever to do with that, and he thought Barnwell had made a very fine job of it.




**TESTING THE ALTITUDE BREAKER: Mr. C. F. Uwins flying the Vickers "Vespa" (Bristol "Pegasus") above the Bristol Channel. The English end of the Severn Tunnel can be seen in the foreground.** (FLIGHT *Photo.*)

At a luncheon given to the visitors by the Bristol Aeroplane Co., Ltd., Sir Stanley White (who is managing director of the Company) said that the thanks of his Company were due to the Air Ministry and Vickers for the help so willingly given.

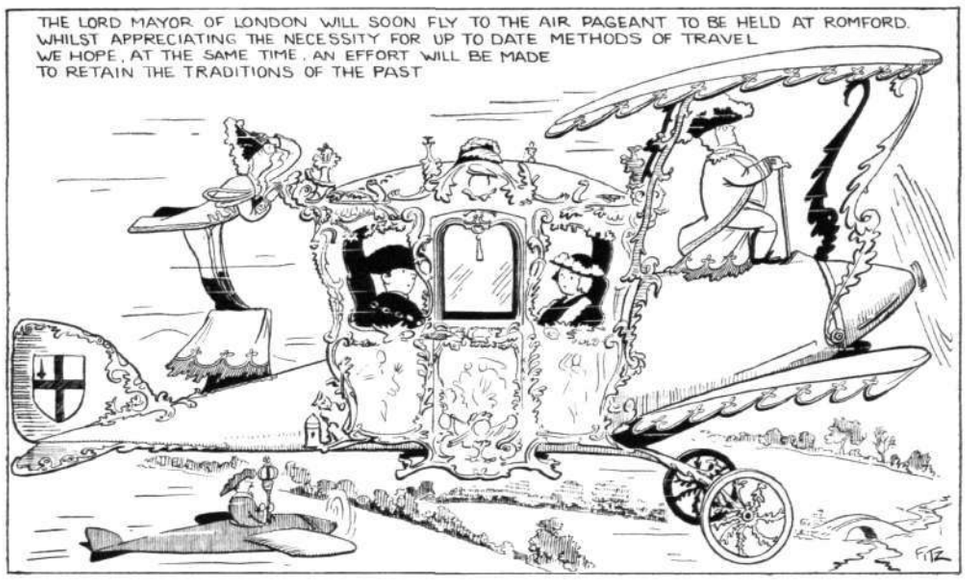


**EQUAL TO 1,100 H.P.: The Bristol "Pegasus" engine would develop at ground level, could it be run at full supercharge, this impressive power. Note the Townend ring cowling.**

Mr. Uwins said he was sorry to have to disappoint those who had expected an account full of excitement. The flight was the outcome of work on supercharging, and was, in fact, an ordinary piece of test flying, uneventful almost to the point of being boring. He recalled that on earlier flights aileron control was lost owing to differences in expansion and contraction of various metal parts. On this flight they had marked the control wires, and when he came down it was found that a relative movement of ¼ in. had taken place, which showed how important it was to take temperature changes into account. The engine gave no anxiety at all, and the carburation was rather better than on a normal flight. The machine was stable at all speeds. As a safety measure a switch had been fitted on the control stick so that, should he have lost consciousness and his hand have slipped from the controls, the engine would have stopped automatically. He felt that he was in a false position over the whole affair. What he had done was nothing. The real credit should go to the directors, who had sanctioned ungrudingly all expense in connection with the flight.

Doubtless our readers will like to learn something of the equipment which enabled Mr. Uwins to stand the extremely low temperature and low air pressures encountered. He wore special clothing, which was electrically heated from a Rotax generator driven by the engine. This generator also supplied current for heating the valves of the oxygen apparatus, on the correct functioning of which so much depended. The clothing and oxygen apparatus was, we understand, lent by the R.A.E., whose design it is, and was manufactured by Siebe, Gorman & Co., Ltd. To make as sure as is humanly possible that there should be no failure of the electricity supply, a specially large Exide accumulator was carried, which would have supplied the current in the event of the engine-driven generator failing.

# THE ESSEX MEETING

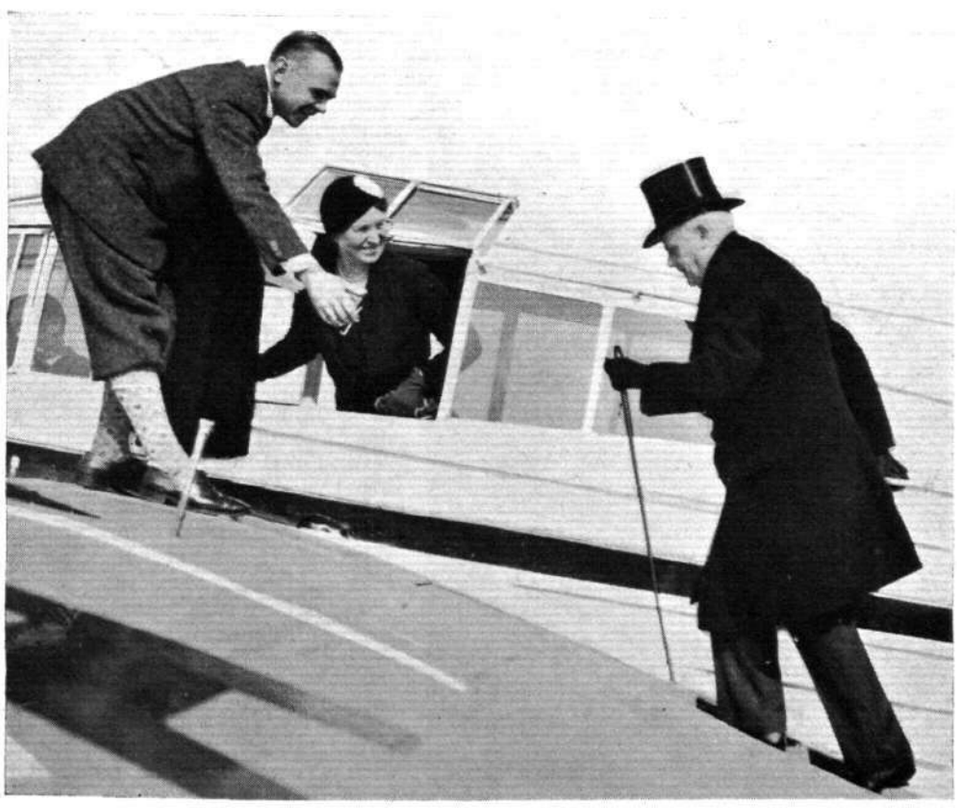



**Drawn in jest—but who knows ?** (*" Daily Mirror " Cartoon.*)

ON Saturday, September 24, Mr. Hillman, of Hillman's Airways & Motor Coaches, gave a party. It was attended not only by thousands of the public, but also by the Lord Mayor of London and Lady Mayoress, Mrs. Lassel Phillips, Col. Shelmerdine (Director of Civil Aviation) and Capt. Massey (City Marshal), who were flown from Heston by Col. L. Strange in the " Spartan Cruiser " (three " Gipsy III's ") and who were followed by Mr. Alderman and Sheriff Greenway and Mrs. Greenway, and Mr. Sheriff Wilkinson in the " Westland Wessex " (three 7-cyl. Genet Majors), flown by Mr. H. A. Penrose. An escort was provided by No. 600 (City of London) (Bomber) Squadron, A.A.F. Over Maylands aerodrome, Romford, they were met by a flight of three " Bristol Bulldogs " of No. 54 (Fighter) Sqd., stationed at Hornchurch. The ostensible reason for this meeting was to engender a feeling in Essex which it is hoped will result in the establishment of an airport for Essex. H.M. Lord Lieutenant for the County of Essex (Brig. Gen. R. B. Colvin) was to have been at the aerodrome to welcome the Lord Mayor and his party on behalf of the civic authorities of the county, but unfortunately ill-health on the part of Gen. Colvin caused a change in the programme, and this duty was carried out by Col. F. H. Whitmore, the Deputy Lieutenant. After the formalities at the aerodrome had finished, the official party drove to the Market Place, where addresses of welcome were presented to Col. Whitmore, representing Gen. Colvin, and to the Lord Mayor by the Romford Urban District Council. This ceremony was witnessed by members of all the various organisations like boys' brigades, scouts, girl guides, British Legion, V.A.D., etc., the majority of whom appeared far more interested in the aeroplanes overhead and the arrival of people like Mr. and Mrs. Mollison and the Hutchinson family.

After this ceremony the party proceeded to the White Hart Hotel, Romford, where they were entertained to lunch as the guests of Mr. Hillman, the lunch being presided over by Col. Whitmore. Col. Whitmore proposed the toast of " The Lord Mayor, Sheriffs and the Corporation of the City of London," and in doing so he read a letter of regret from Gen. Colvin, expressing the latter's sorrow at not being able to be present. Gen. Colvin also drew attention to the fact that our country had been built up by individual enterprise, and he felt therefore that it was the duty of everyone to support such enterprise as that shown by Mr. Hillman, particularly as that enterprise was connected with aviation. In conclusion, Col. Whitmore read a telegram of regret from Sir Alliott Verdon Roe, who was unable to be present. In reply, the Lord Mayor (Sir Maurice Jenks) said that the Corporation of London always took a great interest in the areas surrounding their city, particularly in those matters which were connected with aviation. Flying was a great thing, and he said he thought that it always made one feel better and somewhat superior to other persons who preferred to remain on the ground. He stressed the risks attendant in travelling by car on the road, and said that he felt sure travelling by commercial aviation afforded even less risk than any other means of locomotion.

The Director of Civil Aviation, Col. Shelmerdine, proposed " Success to the Essex Aviation Display." He congratulated the compilers of the programme, and was certain that they were going to have a very admirable meeting. He drew attention to the fact that it was proposed to establish an airport in Essex, a procedure, he said, which was very necessary, for the chief lack of our country at the present time was landing grounds, particularly in the vicinity of our major towns. He disclaimed the necessity for elaborate aerodromes or buildings, and said that all that was now wanted was good landing grounds with a petrol pump and telephone.



**The Lord Mayor of London going on board the Spartan " Cruiser " (three " Gipsy III's ") at Heston. Col. Strange flew the party, which included Col. Shelmerdine, the Director of Civil Aviation, to Maylands Aerodrome, Romford.**

**The Lady Mayoress presenting the Cup to Mr. H. Buckingham for winning the Romford-Clacton Race in a "Fox Moth" ("Gipsy III").**

**The Lord Mayor talking to the pilots of his escort (No. 600, City of London Bomber Squadron, A.A.F.).**

Mr. Edward Hillman, whose party it was, then, in his bluff and hearty manner, returned thanks for the toast. Mr. Hillman is evidently a man of action, and, like most men of the type, a man of few words. He simply asked people for all the support they could give him.

Mr. J. A. Mollison then proposed the toast of "The County of Essex," and after referring to the fine record of Col. Whitmore, he said that the aerodrome and its establishment was entirely the work of Mr. Hillman, and he felt that enterprise of this nature deserved all the help which could be given. Col. Whitmore briefly returned thanks, saying that the County of Essex had always been to the front, having produced many well-known people, starting, he thought, with Cassivelaunus, who led the Icnei against the Romans, while Boudicea was said to have lived at Waltham Abbey, now the home of Gen. Colvin. During the lunch the race to Clacton and back was flown with seven competitors.

Visibility was very poor at the time when competitors in the Hillman Trophy race were expected to arrive at Romford to submit their aeroplanes for the usual inspection. Telephone messages were received which indicated that similar conditions, if not worse, prevailed in most places. Towards noon conditions improved, and the competitors began to arrive, but in some cases, from the way they disappeared over the brow of the downward slope of the aerodrome when landing, we wondered whether they would present their mounts for inspection, safely.

Shortly before 2 o'clock the race was started in visibility conditions which were rather poor. The course, which totalled 90 miles, was from Maylands aerodrome to Clacton, from there to the Redwing factory at Blue Barns aerodrome, near Colchester, and thence to Maylands.

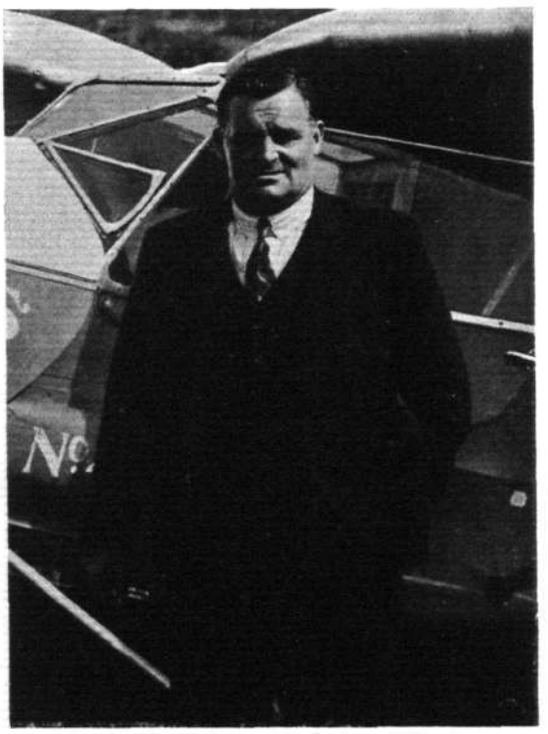
Mr. Pegg, with passenger, on his old 140-h.p. "Clerget Avro," 504K, was first away, and to all appearances, as he took the slight right-handed climbing turn on to the course, seemed to be making good speed. Some 3½ min. later Mr. Lipton, accompanied by his constant racing companion, complete with "Yo-Yo," left on his "Gipsy I Moth," to be followed a few minutes later by Mr. Meadway on Count Johnstone-Noad's "Hermes II Desoutter." Almost immediately another edition of this year's darkest of dark horses, departed piloted by Mr. Buckingham. This D.H. "Fox Moth" had a "Gipsy III" engine, the large tank in the top centre section, and to all intents and purposes appeared to be a standard production model except for the provision of a coupé head. Next away was Miss Crossley on her Comper "Swift" with "Pobjoy R," which spluttered rather and caused a few anxious moments to those who appreciated what might be the result of having to throttle back when almost off the ground on such a down gradient. At intervals of several minutes Mr. Percival flying the "Gull" with "Hermes IV" and Mr. Styran on the Comper "Swift" with "Gipsy III," departed at a high speed into the mist.

The finish of the race, which was expected to be at about 2.50 p.m., was now awaited, with possibly a little anxiety on account of the poor visibility.

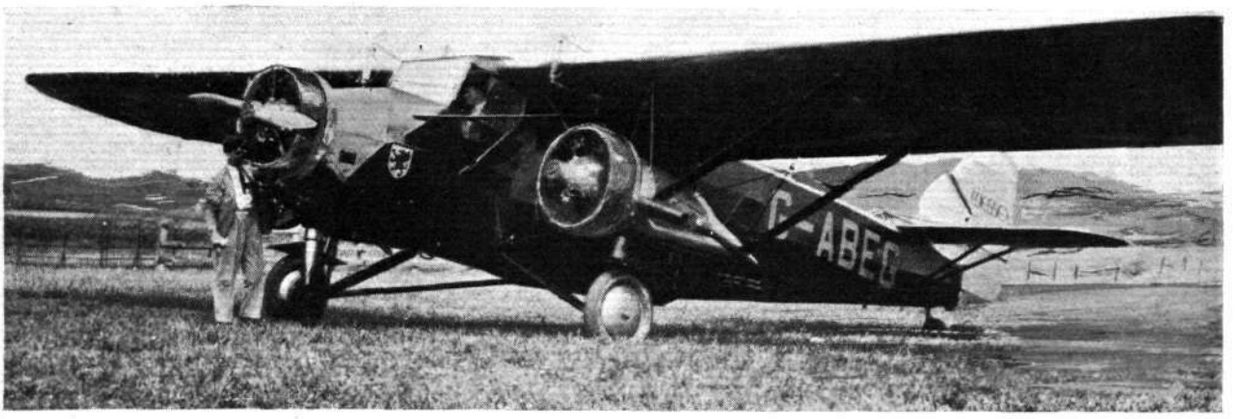
True to its habit of arriving too early—and shall it be said to the surprise or ennui of the handicappers—the "Fox Moth" flown by Mr. Buckingham arrived at 2.48 p.m., to be followed by Mr. Percival on the "Gull" 1 min. 51 sec. later. At intervals of 21 and 27 sec., third and

**HILLMAN TROPHY RACE.**
**Romford—Clacton—Blue Barns—Romford.**

| Pilot. | Aircraft and Engine. | Start. | Finish. | Av. Speed. | Place. |
|---|---|---|---|---|---|
| | | m. s. | m. s. | m.p.h. | |
| Pegg .. | Avro 504k (140 Clerget) | 0 : 00 | 91 : 35 | 59 | 7th. |
| Lipton .. | Moth (Gipsy I) .. | 8 : 26 | 65 : 22 | 95 | 4th. |
| Meadway .. | Desoutter (Hermes II) | 13 : 32 | 64 : 55 | 105 | **3rd.** |
| Buckingham | Fox Moth (Gipsy III) .. | 13 : 59 | 62 : 43 | 110¾ | **1st.** |
| Miss Crossley | Swift (Pobjoy R) .. | 18 : 10 | 65 : 50 | 113½ | 5th. |
| Percival .. | Gull (Hermes IV) .. | 24 : 58 | 64 : 34 | 136½ | **2nd.** |
| Styran .. | Swift (Gipsy III) .. | 27 : 46 | 67 : 05 | 137½ | 6th. |



**Mr. Edward Hillman, the Host of the Meeting.**
(FLIGHT *Photo.*)




**The Westland " Wessex " (three 7-cylinder Genet Majors) which carried some of the Mayor's party from Heston to Romford.** (FLIGHT *Photo.*)

fourth places were secured by Mr. Meadway on the " Desoutter," and Mr. Lipton on his " Moth."

After the arrival of the Lord Mayor at Maylands aerodrome, the meeting was, by him, declared open, a fact which was signified by the start of the fly-past. The aerodrome is by no means a nice one, having a very considerable slope on one side, down which the majority of people, despite the direction of the wind, evidently preferred not to land. As can be imagined, the result was rather hectic, and very soon we had the spectacle of machines taking off and landing across each other much in the same way as we are accustomed to seeing files of Lancers riding through each other from opposite corners of the arena during the annual Army and Navy and Air Force Display at Olympia. However, no accident due to this cause occurred, but nevertheless many were thankful when authority, in the shape of Capt. A. G. Lamplugh, stepped in and cancelled the remainder of the fly-past. It would be as well at this juncture to point out that there is, of course, no possibility of this aerodrome, in its present state, being licensed as the Essex airport. It is merely the private aerodrome of Mr. Hillman, whose enterprise it is hoped will be the means of arousing sufficient local interest to establish a suitable airport in the vicinity.

The weather was very thick in places, so that fog prevented the arrival of many of the machines which should have done so; nevertheless, a very representative gathering was seen, including types of the following aircraft: " Fokker," " Westland Wessex," " Bristol Fighter," " Autogiro," " Puss Moth," " Comper Swift," " Spartan Cruiser," " Fox Moth," " Gull," " Avro Baby," " Avian," " Tom-Tit," " Junkers," " Avro 504K," " Spartan Arrow," " Lockheed Vega," " Hawker Fury," and " Moths " in several forms. The non-arrival of several participants caused the programme to be changed a considerable amount, and after the fly-past, Lt. Com. G. Rodd, R.N., gave a most able demonstration of the flying capabilities of his " Puss Moth." Com. Rodd must, we imagine, have done as much flying, if not more, than anybody in a " Puss Moth," and there is no doubt that he knows its capabilities to an inch. The next, most effective, event was a wireless controlled flying lesson (so-called) by Mr. R. A. C. Brie in an " Autogiro." The " Autogiro " carried a Marconi wireless receiving apparatus, and Mr. Brie's manœuvres were controlled by Mr. Courtenay, whose orders were broadcast from a van on the ground. Flt. Lt. A. G. Hill landed safely, albeit just beyond the confines of the aerodrome, after having jumped from a " Spartan " 3-seater flown by Capt. N. Stack; he used a Russell " Lobe " parachute. The flight of three " Bulldogs " from No. 54 (Fighter) Sqdn., stationed at Hornchurch, which had been flying round for some considerable time, then decided that they had better take a hand in the programme, this already being nearly ¾-hr. late Their manœuvres were just the sort of thing required at this stage to enliven the public who may not have understood the finer points of their movements, but who certainly responded to the roar of the three " Jupiter " engines when flown close over their heads. One very effective manœuvre was commenced in echelon to the left, continued with a half-roll, a dive in line astern and a zoom up over the centre of the aerodrome, finishing in the reverse direction. On one occasion they continued, turning the zoom into a complete roll, formating once more in squadron " Vee " at the top. Shortly afterwards F/O. P. E. G. Sayer took up the Hawker " Fury " (Kestrel) and gave a demonstration which was in every way just as perfect as we are now well accustomed to seeing from him, and which we have already described so many times. He has now developed a spectacular take-off, wherein he holds the machine down until well across the aerodrome and then proceeds to do a nearly vertical climb, and roll at least twice on the way up. On another occasion, after diving at the aerodrome, he turned on his back and finished with a zooming climb for many hundreds of feet in this position. One of the most impressive of his methods of showing off the machine was to fly low across the aerodrome down wind, *flat out, and then to turn and come back again* just hanging in the air at what looked like about 40 m.p.h.

Other machines which were demonstrated were the " Comper Swift," both the " Gipsy " engined and " Pobjoy " engined varieties, the " Percival Gull," " Westland Wessex," " Spartan Cruiser " and the " Lockheed Vega."

Before departing, the Lady Mayoress presented the Hillman Trophy to Mr. Buckingham, the winner of the Clacton race. Early in the afternoon an " Autogiro " landed, which had been flown from Hanworth by Messenger Boy Cabel, of the Commercial Cable Co. This youth, who is a member of the Messenger Boys' Flying Club and who has now done quite a considerable number of hours cross-country in the " Autogiro," carried a cable message from the Mayor of New York to the Lord Mayor of London. A very appropriate reply to this message was returned in the same manner.

## A LADIES' PARTY AT SYWELL

ON Sunday, September 25, the ladies of the Northamptonshire Aero Club held the second of their annual flying meetings. This year the meeting, once more ably organised by Miss Mollie Olney, was more in the nature of a garden party, the general public not therefore being invited. Some dozen visiting machines arrived at the aerodrome during the afternoon, quite a large proportion of which were flown by lady pilots. Unfortunately, other meetings in the country clashed with this gathering, thereby lessening the number of visitors. Last year the handsome cup, presented by Mr. Lee Champion, was won by Miss " Susan " Slade in a race which, it will be remembered, was distinctive for its somewhat exciting(!) finish. This year, however, the idea of a race was abandoned and a competition substituted. The cup, it was decided, should still be presented to the winner, and therefore Miss Slade had perforce to fly up from Cornwall with this " utensil," which she managed to do despite the execrable weather. Miss Slade told us that she explored every valley in Somerset in an endeavour to get north from Cornwall on the first day of her attempt before returning to a field belonging to some friends in Taunton. On the second day she was more lucky, and by avoiding the hills she was able to get through. The competition took the form of a test of the pilot's ability to fly accurately by compass without the aid of a map. All entrants were given maps,

**ON THE LAWN AT SYWELL : A group watching the flying during the Ladies' Meeting.**

but these were sealed and the breaking of the seal entailed disqualification. Four bearings and distances were given with landmarks, which had to be noted at each corner, observers being stationed at these marks. As a precaution against the eventuality of several competitors getting round the course correctly they had, on their return to the aerodrome to land, finishing their landing run with their wheels as near to a line of flags as possible. Points being deducted according to the distance they were from these flags. The entrants included Miss "Susan" Slade, "Moth" ("Gipsy I"); Lady Bailey, "Puss Moth" ("Gipsy III"); Miss Giles, "Moth" ("Gipsy I"); Miss Muntz, "Comper Swift" ("Pobjoy"); Miss Aitken, "Moth" ("Gipsy I"). A scientific scheme of marking was evolved by several of the enthusiastic male members of the club, and the result of their labours was to award Lady Bailey 66.25, Miss Giles 63.5, Miss Slade 62.5, and Miss Muntz 61.25. Unfortunately Miss Aitken decided that if she continued looking for the landing marks any longer she would be in danger of losing her tea, and she therefore opened her maps, which, of course, entailed her disqualification.

## THE YORK COUNTY MEETING

THE weather on Sunday morning, September 25, at Sherburn provided excellent visibility for those competing in the Yorkshire Trophy Race.

This race, over a distance of 175½ miles, consisted of two triangular circuits, flown consecutively without landing. Somewhere on each leg of the course, but not within 5 miles of a turning point, were placed ground marks in the form of letters. Briefly, the object was that competitors had to identify the six marks, failure to do so resulting in the addition of 2 min. to their flying time for every mark not correctly identified. By this means a premium was placed on accurate course-keeping.

**THE PRESENTATION : (Left to right) Mrs. Rhodes-Moorhouse (presenting the Cup), Miss Olney, Mrs. Shelmerdine, Lady Bailey (the winner, who flew Mrs. Shelmerdine back to London after the event).**

The start was timed for 1 o'clock, by which time all the competitors appeared to be well keyed up for the task before them, and doubtless all hoped that they had guessed where the ground marks were likely to be displayed.

The order in which they started and the starting times are shown in the table below :—

**YORKSHIRE TROPHY RACE.**

| Pilot. | Aircraft and Engine. | Start. | Finish. | Av. Speed. | Place. |
|---|---|---|---|---|---|
| | | m. s. | h. m. s. | m.p.h. | |
| Tyson .. | Spartan (Hermes II) | 0 : 00 | 2 : 01 : 04 | 87¼ | — |
| Strange .. | Spartan (Hermes IIB) | 0 : 00 | 1 : 51 : 44 | 94½ | **2nd.** |
| Blake .. | Bluebird(Hermes II) | 11 : 53 | 2 : 05 : 08 | 93⅛ | — |
| Shaw .. .. | Cadet (Genet Major) | 13 : 42 | — | — | — |
| Miss Crossley | Swift (Pobjoy R) | 20 : 20 | 1 : 59 : 27 | 106½ | — |
| L. Grimthorpe | Puss Moth (Gipsy III) | 22 : 35 | 2 : 02 : 51 | 105¼ | — |
| Scott .. | Puss Moth (Gipsy III) | 24 : 44 | 1 : 51 : 26 | 121¾ | — |
| Leech .. | Active (Hermes IIB) | 27 : 26 | 1 : 54 : 20 | 121½ | **3rd.** |
| Percival .. | Gull (Hermes IV) .. | 34 : 05 | 1 : 51 : 22 | 136½ | **1st.** |

At the end of the first circuit Lt. Col. Strange had taken the lead ; Miss Crossley, Mr. Scott and F/O. Leech had all gained places, and Mr. Percival, although still at the end of the field, was obviously gaining ground.

The race was timed to finish at 2.50 p.m., and less than a minute after that time three machines appeared in sight, making a close run for the finish. They proved to be the "Gull" flown by Mr. Percival, the "Puss Moth" by Mr. Scott and the Spartan 3-seater by Lt. Col. Strange. They finished in that order with 4 sec. separating first and second and 18 sec. second and third.

Immediately they had landed the officials collected the cards on which they had indicated the marks they had identified. Mr. Percival thought he had got one wrong ; Mr. Scott said he had missed three. On landing, Mr. Leech reported considerable difficulty in finding the last turning point, a difficulty which it was gathered was also experienced by several other competitors. During the next quarter of an hour the remaining competitors turned up and a short interval ensued, following which the result of this event was declared.

The novelty of having to find the ground marks undoubtedly gave an added interest to the race. The event was such as to need careful and good organisation, and the officials of the Yorks County Aero Club are certainly to be congratulated on the success they made of it.

Between the start of the second stage of Trophy race and the finish, Mr. Ivor Thompson, as instructor, and another member of the Club as pupil, gave an exhibition of a pupil's first attempt at aerobatic flying on a "Bluebird," and after the final of the Sherburn Short Handicap F/O. Leech gave one of his thrilling, if not hair-raising, displays on the "Arrow Active."

The Sherburn Short Handicap over a course of three laps totalling 19 miles, run off in two heats and a final, resulted in a close finish ; particularly thrilling being the dead heat between Mr. Percival ("Gull") and Mr. Styran ("Gipsy Swift") for third place. Miss Leathart, "Moth" ("Cirrus II") was first and Mr. Scott, "Puss Moth" ("Gipsy III") second. W. D.

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FLIGHT ENGINEERING SECTION

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CONTENTS



## AN INVESTIGATION OF RANGE AND ENDURANCE

By G. B. FENTON.* B.Sc.(Eng.) London, A.F.R.Ae.S.

The object of this investigation is to derive comparatively simple formulæ which can be used to indicate range and endurance during the early stages of the design of an aircraft. The derivation of such formulæ, in fact, any analytical investigation of aircraft performance, must be based on certain fundamental assumptions, and in the present case it is proposed to state the assumptions made, and to discuss their validity before proceeding with the analytical work.

It is assumed in the investigation :—

(1) That the specific fuel consumption in lb. per brake horse-power hour is constant over the greater part of the cruising speed range.

(2) That the airscrew efficiency is also constant for the cruising speeds considered.

(3) That the profile drag coefficient of the complete aircraft (wing + parasite), with allowance for slipstream effect, can be expressed in the form $\theta + \phi K_L^2$ where $\theta$ and $\phi$ are constants and $K_L$ is the lift coefficient at any speed.

Considering these assumptions :—

### (1) Constant specific fuel consumption

Actually, the specific consumption of an engine increases as the engine is throttled down, but, from a number of calculations done at various times, a figure for the throttled specific consumption of $p = 1{\cdot}05\ p_o$ is indicated as a fair mean for use in the following formulæ : where $p_o$ lb. per B.H.P. per hour is the consumption at normal r.p.m. at full throttle. A study of the throttled consumption curves published for modern aero engines also shows that the assumption of a constant figure over the cruising range will not lead to large errors. The effect will be to overestimate the ranges at low speeds in the neighbourhood of the most economical cruising speed, and underestimate to some extent at high speeds approaching the top speed of the aircraft.

It should be noted that the formulæ derived are applicable to any altitude only if the specific consumption $p$ is the particular one for that altitude. The variation of $p_o$ with altitude can be obtained from "The Handbook of Aeronautics," page 127, and the necessary correction to $p$ made in considering altitudes other than sea level.

### (2) Constant Airscrew Efficiency

If the airscrew is working at maximum efficiency at top speed (the usual design case), the efficiency will not vary in throttled flight more than about 4 per cent. from top speed to most economical cruising speed. It is suggested that $\eta$ in the formulæ is taken as $\eta_m - 2$ per cent., where $\eta_m$ is the maximum efficiency of the airscrew.

### (3) Profile Drag

Let $k_{Do}$ = the minimum profile drag coefficient of the aircraft gliding (*i.e.*, no slipstream correction).

This consists of $k_{Do}$ (wing) + $k_{Do}$ (extra to aerofoil), and is assumed to be constant with angle of attack over the cruising range considered.

A correction must be applied to this to allow for the slipstream in level flight (throttled) as follows :—

It can be shown easily from the momentum theory, that

$$\frac{V_s}{V} = \sqrt{1 + \frac{4T}{Z\rho V^2}} \quad \ldots\ldots\ldots\ldots (1)$$

where $V_s$ = slipstream speed in ft. per second.
$V$ = forward speed in ft. per second.
$T$ = thrust in lb.
$\rho$ = relative density
$Z = 0{\cdot}00331\ D^2$ where $D$ = airscrew diameter in ft.

Now, for level throttled flight Thrust = total drag.

$$\therefore\ NT = (\overline{k_{Do}} + k_{Di}) \times 0{\cdot}00237\rho\ SV^2 \quad \ldots\ldots (2)$$

where $\overline{k_{Do}}$ = profile drag coefficient corrected for slipstream.
$k_{Di}$ = induced drag coefficient.
$S$ = wing area in square feet.
$N$ = number of engines.

Substituting in (1)

$$\frac{V}{V} = \sqrt{1 + \frac{4\,(\overline{k_{Do}} + k_{Di})\ 0{\cdot}00237\ \rho SV^2}{NZ\rho V^2}}$$

$$= \sqrt{1 + \frac{4\,(\overline{k_{Do}} + k_{Di})\ 0{\cdot}00237\ S}{NZ}} \quad \ldots (3)$$

* Mr. Fenton has been attached to the Technical Staff of the Blackburn Aeroplane & Motor Co., Ltd., for a number of years, and has specialised particularly on performance and stability, and general aerodynamic work, as well as on airscrew design.

Now, if $b$ = proportion of profile drag in the slipstream

$$\overline{k_{Do}} \times 0{\cdot}00237\rho\, SV^2 = 0{\cdot}00237\rho\, S\,[b\, k_{Do}\, V_s^2 + (1-b)\, k_{Do}\, V^2]$$

$$\therefore\ \overline{k_{Do}} = b\, k_{Do} \left(\frac{V_s}{V}\right)^2 + (1-b)\, k_{Do}$$

$$= k_{Do}\left[b\left\{\left(\frac{V_s}{V}\right)^2 - 1\right\} + 1\right] \quad \ldots\ldots\ (4)$$

Substituting (3) in (4)

$$\overline{k_{Do}} = k_{Do}\left[b\left\{1 + \frac{4\,(\overline{k_{Do}} + k_{Di}) \times 0{\cdot}00237\ S}{NZ} - 1\right\} + 1\right]$$

This reduces to

$$\overline{k_{Do}}\left(1 - \frac{4b \times 0{\cdot}00237S\ k_{Do}}{NZ}\right) = k_{Do}\left(1 + \frac{4b \times 0{\cdot}00237S\ k_{Di}}{NZ}\right)$$

$$i.e.,\ \overline{k_{Do}} = k_{Do}\left[\frac{NZ + 4b \times 0{\cdot}00237S \cdot k_{Di}}{NZ - 4b \times 0{\cdot}00237S \cdot k_{Do}}\right]$$

Now, induced drag coefficient $k_{Di} = C\,K_L^2$

where C is a constant depending on the wing arrangement

$$\therefore\ \overline{k_{Do}} = k_{Do}\left[\frac{NZ + 4b \times 0{\cdot}00237\ SC\ K_L^2}{NZ - 4b \times 0{\cdot}00237\ S\ k_{Do}}\right] \quad \ldots\ (5)$$

This gives $\overline{k_{Do}} = \theta + \phi\, K_L^2 \quad \ldots\ldots\ (6)$

where

$$\theta = k_{Do}\left\{\frac{NZ}{NZ - 4b \times 0{\cdot}00237S\ k_{Do}}\right\}$$

$$\phi = k_{Do}\left\{\frac{4b \times 0{\cdot}00237SC}{NZ - 4b \times 0{\cdot}00237S\ k_{Do}}\right\}$$

If sufficient machine data is known, the constants are easily calculated, but in the absence of more accurate data, the following values may be taken

$\theta = 1{\cdot}1\ k_{Do}$ for all machines.

$\phi = 0{\cdot}5\ k_{Do}$ for multi-engined aircraft with engines mounted on the wings.

$\phi = 0{\cdot}8\ k_{Do}$ to $1{\cdot}2\ kD_0$ for single-engined aircraft with tractor airscrew mounted in the nose.

$\phi$ is more susceptible to the aircraft and airscrew dimensions and, if possible, should be calculated for the particular case under consideration.

Values of C in the equation for induced drag coefficient are obtained by the usual Prandtl methods, and are plotted for quick reference in Figs. 1 and 2 for rectangular monoplanes and equal span-chord biplanes.

Now, in the light of the above assumptions, consider a machine cruising at a speed of V ft. per sec. at any altitude.

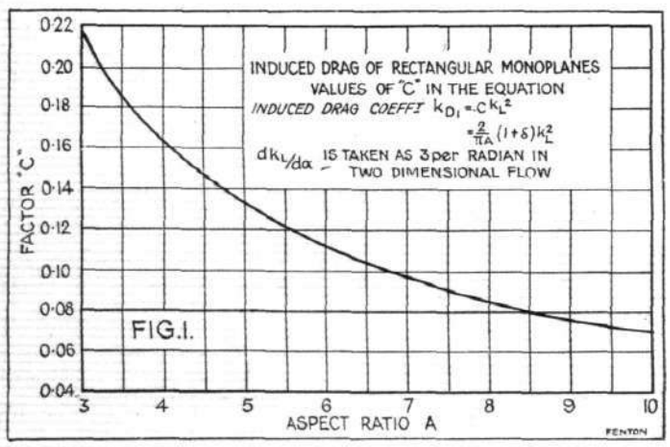
Let $p$ = the specific consumption in lbs. per B.H.P. per hour.

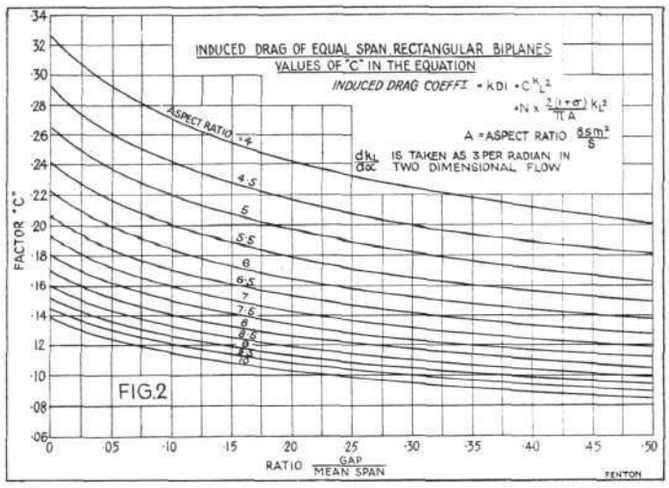
P = actual consumption in lbs. per hr.

$\therefore$ P = $p$H where H = Brake horse power.

Now at any speed V Thrust HP =

$$\text{Drag} \times \frac{V}{550} = (\overline{k_{Do}} + k_{Di}) \times 0{\cdot}00237\ \rho\ SV^2 \times \frac{V}{550}$$




and since $k_{Di} = CK_L^2 = \dfrac{C\,W^2}{0{\cdot}00237^2\,\rho^2\,S^2\,V^4}$

where W = weight of aircraft in lbs.

$$\text{Thrust HP} = \frac{\overline{k_{Do}} \times 0{\cdot}00237\ \rho\ SV^3}{550} + \frac{CW^2}{550 \times 0{\cdot}00237\ \rho\ SV}$$

Now from assumption (3)

$$\overline{k_{Do}} = \theta + \phi\, K_L^2 = \theta + \frac{\phi\, W^2}{0{\cdot}00237^2\,\rho^2\,S^2\,V^4}$$

$\therefore$ Thrust

$$\text{HP} = \frac{\theta \times 0{\cdot}00237\ \rho\ SV^3}{550} + \frac{W^2(\phi + C)}{550 \times 0{\cdot}00237\ \rho\ SV} \quad \ldots\ (7)$$

$\therefore$ If $\eta$ = aircrew efficiency

brake horse power taken from engine

$$= \frac{1}{550\eta}\left\{0{\cdot}00237\ \rho\ SV^3\theta + \frac{W^2(\phi + C)}{0{\cdot}00237\ \rho\ SV}\right\}$$

$$\therefore\ P = \frac{p}{550\eta}\left\{0{\cdot}00237\ \rho\ SV^3\ \theta + \frac{W^2(\phi + C)}{0{\cdot}00237\ \rho\ SV}\right\} \quad \ldots\ (8)$$

Let $m$ = lbs. of petrol used per foot travelled $= \dfrac{P}{3600V}$

$$\therefore\ m = \frac{p}{3600 \times 550\eta}\left\{0{\cdot}00237\ \rho SV^2\theta + \frac{W^2(\phi + C)}{0{\cdot}00237\ \rho\ SV^2}\right\} \quad (9)$$

Now at the most economical cruising speed, $m$ is a minimum

*i.e.*, $dm/dV = 0$

Differentiating (9) with respect to V, and equating to O, we get

$$V^4 = \left(\frac{\phi + C}{\theta}\right)\left(\frac{W}{0{\cdot}00237\ \rho\ S}\right)^2$$

*i.e.*, most economical cruising speed

$$V_c = \sqrt[4]{\frac{\phi + C}{\theta}} \times \left(\frac{w}{0{\cdot}00237\ \rho}\right)^{\frac{1}{2}} \text{ ft. per sec.} \quad \ldots\ (10)$$

where $w$ = wing loading $= \dfrac{W}{S}$ lb. per sq. ft.

## FORMULÆ FOR RANGE

Two cases will be considered.

($a$) Range at constant speed, neglecting the variation in gross weight of the aircraft during the flight. This case should only be used when the weight of petrol carried is a small proportion of the total weight.

If Gross wt. of aircraft = W lb.

Weight of petrol = $W_P$ lb.

Then Range R feet $= \dfrac{W_P}{m}$

and from equation (9)

$$R = \frac{W_P}{\frac{p}{3600 \times 550\eta}\left\{0{\cdot}00237\,\rho\,SV^2\,\theta + \frac{W^2(\phi + C)}{0{\cdot}00237\,\rho\,SV^2}\right\}} \quad (11)$$

The cruising speed is taken as K × most economical cruising speed, *i.e.*, $V = KV_C = K \times \sqrt[4]{\frac{\phi + C}{\theta}} \times \left(\frac{w}{0{\cdot}00237\,\rho}\right)^{\frac{1}{2}}$

where K is any chosen constant.

Substituting for V in equation (11) and simplifying, we get

Range R ft.

$$= \frac{3600 \times 550\eta}{p} \cdot \frac{K^2}{(1 + K^4)} \cdot \frac{1}{[\theta(\phi + C)]^{\frac{1}{2}}} \cdot \frac{W_P}{W} \text{ ft.}$$

*i.e.*, Range

$$= \frac{375\eta}{p} \cdot \frac{K^2}{(1 + K^4)} \cdot \frac{1}{\sqrt{\theta\,(\phi + C)}} \cdot \frac{W_P}{W} \text{ miles} \quad . \quad (12)$$

(*b*) Range at a constant proportion of the most economical cruising speed taking into account the variation of this speed with gross weight of aircraft.

Let $W_o$ = gross weight at beginning of flight

$W_F$ = gross weight at end of flight.

*i.e.*, Weight of petrol used = $W_o - W_F$.

NOTE.—Strictly, the amount of oil used should be taken into account in the weight change, but this is a very small correction, and may be neglected.

Now in this case

$$dR = \frac{dW}{m}$$

$$\therefore \quad dR = \frac{dW}{\frac{p}{3600 \times 550\eta}\left\{0{\cdot}00237\,\rho\,SV^2\theta + \frac{W^2(\phi + C)}{0{\cdot}00237\,\rho\,SV^2}\right\}} \quad . \quad (13)$$

Taking, as before, $V = KV_C = K \times \sqrt[4]{\frac{\phi + C}{\theta}} \times \left(\frac{w}{0{\cdot}00237\,\rho}\right)^{\frac{1}{2}}$

and substituting in (13), we get by simplification

$$dR = \frac{3600 \times 550\eta}{p} \cdot \frac{K^2}{(1 + K^4)} \cdot \frac{1}{\sqrt{\theta(\phi + C)}} \cdot \frac{dW}{W}$$

Integrating between the limits $W_o$ and $W_F$ gives

$$\text{Range R ft.} = \frac{3600 \times 550\eta}{p} \cdot \frac{K^2}{(1 + K^4)} \cdot \frac{1}{\sqrt{\theta\,(\phi + C)}} \times 2{\cdot}3 \log \frac{W_o}{W_F} \text{ ft.}$$

*i.e.*, Range $R = A \log \frac{W_o}{W_F}$ miles . . . . . (14)

where $A = \frac{863\eta}{p} \cdot \frac{K^2}{(1 + K^4)} \cdot \frac{1}{\sqrt{\theta\,(\phi + C)}}$.

The similarity between this formula and the formula of Breguet will be noted.

The endurance under these conditions is found as follows :—

If $dW$ = weight of petrol used in $dH$ hours,

$$dH = \frac{dW}{P} \text{ where P = consumption in lb./hr.}$$

$\therefore$ From equation (8)

$$dH = \frac{dW}{\frac{p}{550\eta}\left\{0{\cdot}00237\,\rho\,SV^3\theta + \frac{W^2(\phi + C)}{0{\cdot}00237\,\rho\,SV}\right\}} \quad . \quad (15)$$

and as $V = KV_C = K \times \sqrt[4]{\frac{\phi + C}{\theta}} \times \left(\frac{W}{0{\cdot}00237\,\rho\,S}\right)^{\frac{1}{2}}$

By substitution and simplification

$$dH = \frac{550\eta}{p} \times \frac{K}{(1 + K^4)} \times \frac{(0{\cdot}00237\,\rho\,S)^{\frac{1}{2}}}{\sqrt{\theta(\phi + C)^3}} \cdot \frac{dW}{W^{3/2}}$$

Integrating between the limits $W_o$ and $W_F$ gives

$$\text{Endurance H hr.} = \frac{2 \times 550\eta}{p} \times \frac{K}{(1 + K^4)} \times \frac{(0{\cdot}00237\,\rho\,S)^{\frac{1}{2}}}{\sqrt[4]{\theta(\phi + C)^3}}\left(\frac{1}{W_F^{\frac{1}{2}}} - \frac{1}{W_o^{\frac{1}{2}}}\right)$$

$$= B\left[\frac{1}{W_F^{\frac{1}{2}}} - \frac{1}{W_o^{\frac{1}{2}}}\right] \text{ hours} \quad . \quad (16)$$

where $B = \frac{1100\eta}{p} \cdot \frac{K}{(1 + K^4)} \times \frac{\sqrt{0{\cdot}00237\,\rho\,S}}{\sqrt[4]{\theta\,(\phi + C)^3}}$

Then the mean cruising speed during the flight is given by

$$\frac{\text{Range}}{\text{Endurance}} = \frac{R}{H} = V_m \text{ m.p.h.}$$

The expression for $Vm$ m.p.h. is found to be

$$V_m = 0{\cdot}784\left(\frac{\phi + C}{\theta}\right)^{\frac{1}{4}} \cdot \frac{(W_o W_F)^{\frac{1}{2}}}{(W_o^{\frac{1}{2}} - W_F^{\frac{1}{2}})} \cdot \log \frac{W_o}{W_F} \cdot \frac{K}{(0{\cdot}00237\rho S)^{\frac{1}{2}}} \text{ m.p.h.} \quad (17)$$

This is obtained by dividing Equation (14) by Equation (16).

From the endurance formula (Equation 16) the value of K to give maximum endurance may be calculated easily by differentiating H with respect to K and equating to O.

*i.e.*, $H = Q \cdot \frac{K}{1 + K^4}$

where $Q = \frac{1100\eta}{p} \cdot \frac{\sqrt{0{\cdot}00237\rho\,S}}{\sqrt[4]{\theta\,(\phi + C)^3}}\left(\frac{1}{W_F^{\frac{1}{2}}} - \frac{1}{W_o^{\frac{1}{2}}}\right)$

$$\therefore \quad \frac{dH}{dK} = \frac{Q\,(1 - 3K^4)}{(1 + K^4)^2} = O \text{ for a maximum}$$

$$\therefore \quad K = \sqrt[4]{\frac{1}{3}} = \underline{\underline{0{\cdot}76}}$$

*i.e.*, the speed for maximum endurance is 0·76 × most economical cruising speed.

This can be shown also by differentiating P (the consumption in lb./hr.) with respect to V and equating to zero, since the speed for maximum endurance is, obviously, the speed at which the consumption is a minimum.

It should be noted that the speed for maximum endurance is not a practical flying speed, being very near the stalling speed of the aircraft and also outside the range of the assumptions made at the beginning of this article.

To use the formulæ, the most economical cruising speed $V_C$ is first obtained from equation 10, using the aircraft characteristics, and then the appropriate range formula used for any desired speed $KV_C$.

These formulæ, due to the assumptions made, do not provide a means of estimating accurately the range and endurance throughout the cruising range. This can only be done by using actual horse-powers, specific consumptions, and airscrew efficiencies. However, based as they are, on the fundamental characteristics of the aircraft and engine, they do give a rapid means of indicating the range at any cruising speed, sufficiently accurate for preliminary design work, before full performance estimates are available.

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## APPLICATIONS OF THE POLAR DIAGRAM

By E. H. ATKIN, B.Sc.(Lond.)

(*Continued from page* 64)

### Strut No. 1. Middle Half Stiffened

This strut is 2½ in. O/D 16 S.W.G. at the ends, 130 in. long and the middle 65 in. has a moment of inertia twice as great as the ends. It is subjected to an end load of 4,360 lb.

The eccentricity is calculated as before, hence

$$\delta = \frac{130}{600} + \frac{2{\cdot}5}{40}$$

$$= 0{\cdot}2795 \text{ in.}$$

And the end moments are therefore

$$0{\cdot}2795 \times 4{,}360 = 1{,}217 \ lb.\ in.$$

The data required is given in the following table :—

| Section. | AB | BC | CD. |
|---|---|---|---|
| P lb. ... ... ... | 4,360 | 4,360 | 4,360 |
| $\mu^2$ in.$^{-2}$ ... ... ... | 0·0004 | 0·0008 | 0·0004 |
| $\mu$ in. ... ... ... | 0·02 | 0·0283 | 0·02 |
| $a$ in. ... ... ... | 32·5 | 65 | 32·5 |
| $\alpha^\circ$ ... ... ... | 37·3° | 105·4° | 37·3° |

The complete diagram is shown in Fig. 3 (*a*). The construction is as for the tapered strut, and it should be noted that in this case (as also in the case of the taper strut), it is unnecessary to go right through the construction from both sides of the diagram. The symmetry of the strut implies symmetry of the apices ; therefore having obtained $X_3$ we may determine $X_1$ from this consideration.

The maximum bending moment is found to be 13,650 *lb. in*

| Section | AB | BC | CD |
|---|---|---|---|
| P lbs. ... ... | 4,360 | 4,360 | 4,360 |
| $\mu^2$ ins.$^{-2}$ ... ... | 0·0008 | 0·0004 | 0·0008 |
| $\mu$ ins.$^{-1}$ ... ... | 0·0283 | 0·02 | 0·0283 |
| $a$ ins. ... ... | 32·5 | 65 | 32·5 |
| $\alpha^\circ$ ... ... | 52·7° | 74·6° | 52·7° |

The eccentricity and end moments are as for No. 1, and the resulting diagram is shown in Fig. 4 (*a*).

From the direction in which the apices lie, it is inferred that the diagram has no physical significance for us, because we have passed the instability point and, therefore, the strut must have broken at a lower load.

To obtain the instability angle we must this time reduce the total $\alpha$ angle by 19·5°. The modified data is then as follows :—

$$\alpha\,AB = \alpha\,CD = 52{\cdot}7^\circ \times \left(\frac{160{\cdot}5^\circ}{180{\cdot}0^\circ}\right) = 47^\circ$$

$$\alpha\,BC = 74{\cdot}6^\circ \times \left(\frac{160{\cdot}5^\circ}{180{\cdot}0^\circ}\right) = 66{\cdot}5^\circ$$

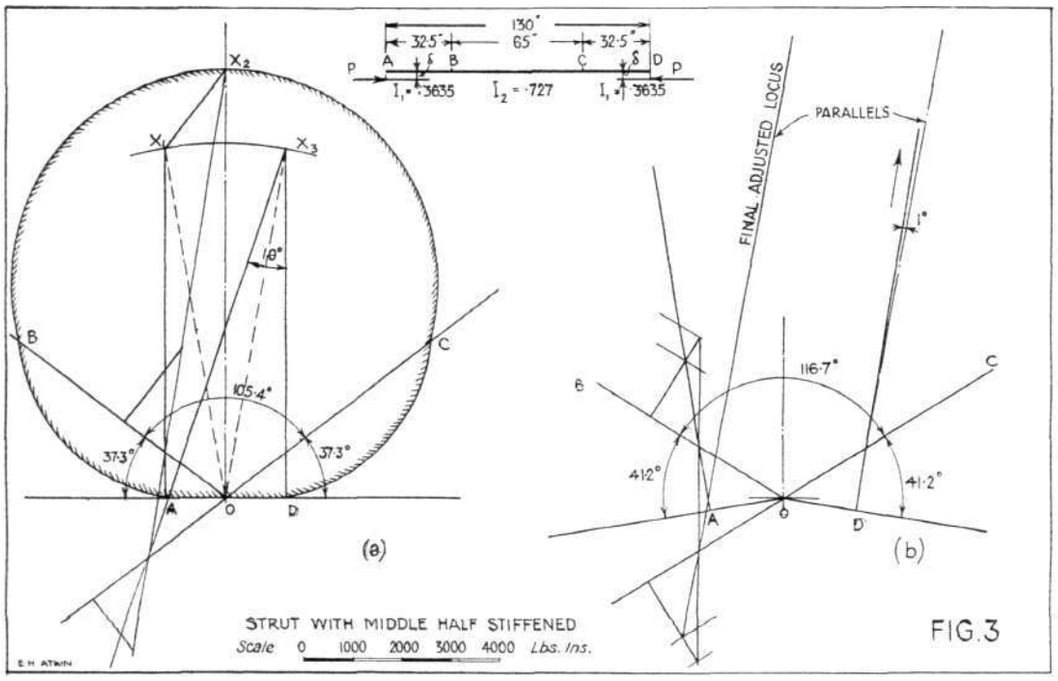



FIG.3

To calculate the modified Euler instability angle we first note that to a first approximation, we are 19° away from it.

Increase therefore the total angle to 199°.

The new values of the quantities we require are

$$\alpha\,AB = \alpha CD = 37{\cdot}3^\circ \times \frac{199^\circ}{180^\circ} = 41{\cdot}2^\circ$$

$$BC = 105{\cdot}4^\circ \times \frac{199^\circ}{180^\circ} = 116{\cdot}7^\circ$$

$$\text{End moments} = 1{,}217 \times \left(\frac{199}{180}\right)^2 = 1{,}487 \ lb.\ in.$$

The revised diagram is shown in Fig. 3 (*b*)

In this case we are only 1° away from the instability point and may safely say that the instability angle is 200°.

### Strut No. 2. End Quarters Stiffened

This strut is 2½ in. O/D 16 S.W.G. in the middle, while 32·5 in. at each end has a moment of inertia twice as great as the middle. The other particulars are exactly the same as for Strut No. 1.

$$\text{End Moments} = 1217 \times \left(\frac{160{\cdot}5^\circ}{180{\cdot}0^\circ}\right)^2 = 968 \ lbs.\ ins.$$

Drawing the diagram to these figures, we discover that we are 0·5° *less* than the critical angle, so that the critical angle is 161°.

We see very vividly from the foregoing calculations how the position of stiffening on a strut can produce a variation of nearly 40° in what we have called the *Modified Euler Instability Angle*, and can make for the same loads all the difference between *stability* and *instability*.

In both cases 180° is no indication of instability.

### (5) The Critical Case

The discussion of the previous sections will have given the reader the impression that for any single bay there is in every case a modified Euler instability angle for which the bay moment becomes infinite.

While this is true generally, there is a very special critical case in which the bay moment remains finite at the instability angle.

For reasons which will appear later, this case is graphically indeterminate, and the requisite analysis is difficult.

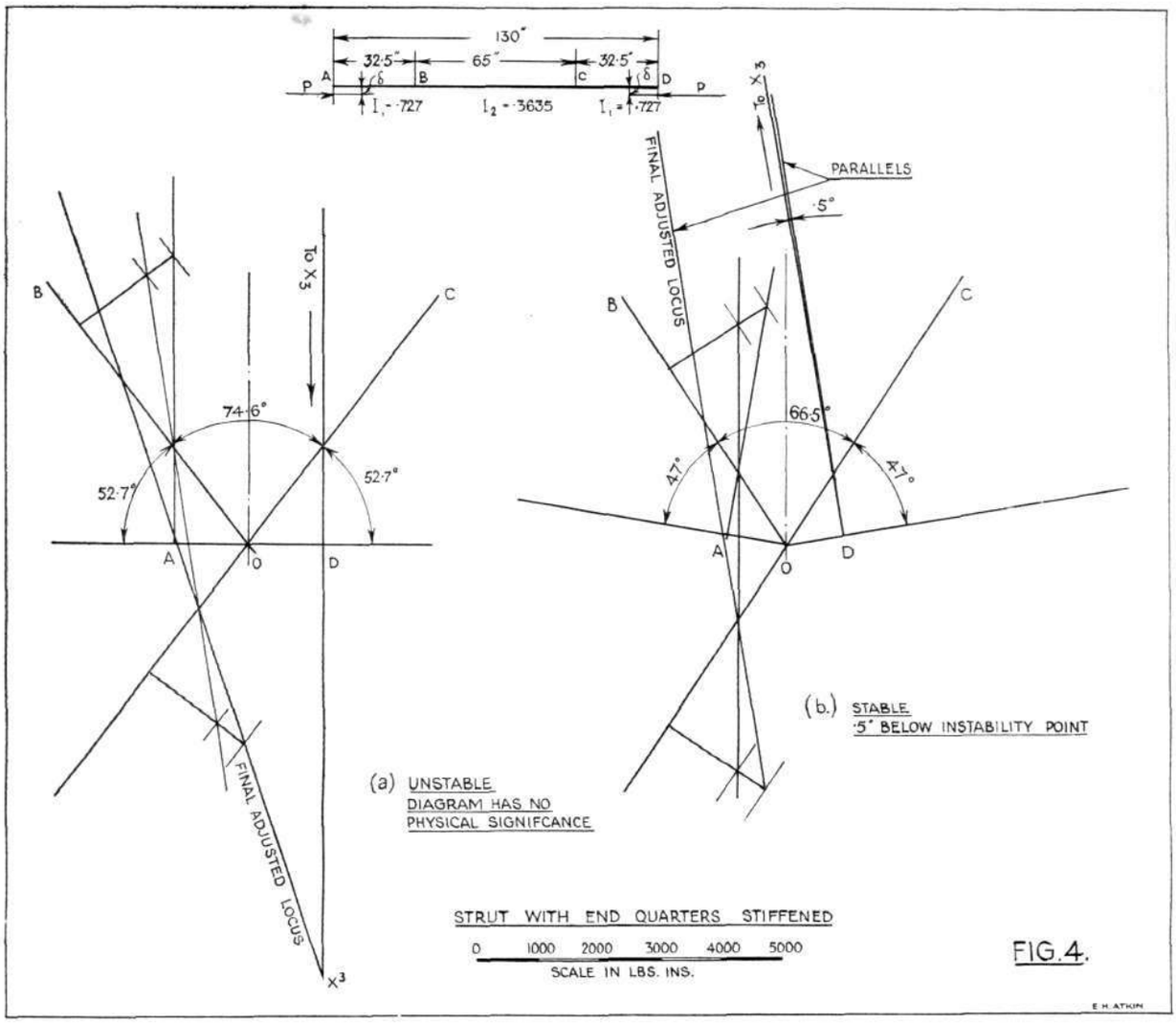



FIG.4.

Further, as long as we are concerned with single bays, the case can never arise in real life, because it depends upon a precise relationship between the loads and moments applied which can scarcely arise and never be guaranteed.

Nevertheless this case *is* interesting practically: its existence is essential to the possibility that a bay of a continuous beam may have an $\alpha$ angle greater than its instability angle without having passed through a condition of instability.

Having justified the inclusion, in a practical article, of a construction apparently of merely theoretical interest, we now proceed to see how this case arises.

We shall limit ourselves to an elementary description of the simple diagram when the moment of inertia is constant throughout the span.

Fig. 5 shows the simplest case that can arise—a uniform lateral load with end moments.

In general, as $\alpha$ approaches $\pi$ the apex X moves to infinity. If, however, the ratios between the applied loads and moments is such that when $\alpha = \pi$, $\frac{L}{2}(M_A + M_B) = \frac{w}{\mu^2}$ we are confronted with a peculiar state of affairs. The perpendiculars to OA and OB through R are coincident, X is therefore graphically indeterminate, and we are compelled to resort to analysis in order to obtain a quantity which will fix X.

This analysis will now be performed for the simple case of Fig. 5.

From Fig. 6 AX is given by the equation

$$(AO + OC)\cot\alpha = AX$$
$$\text{or } (m_A + m_B \sec)\cot = AX$$

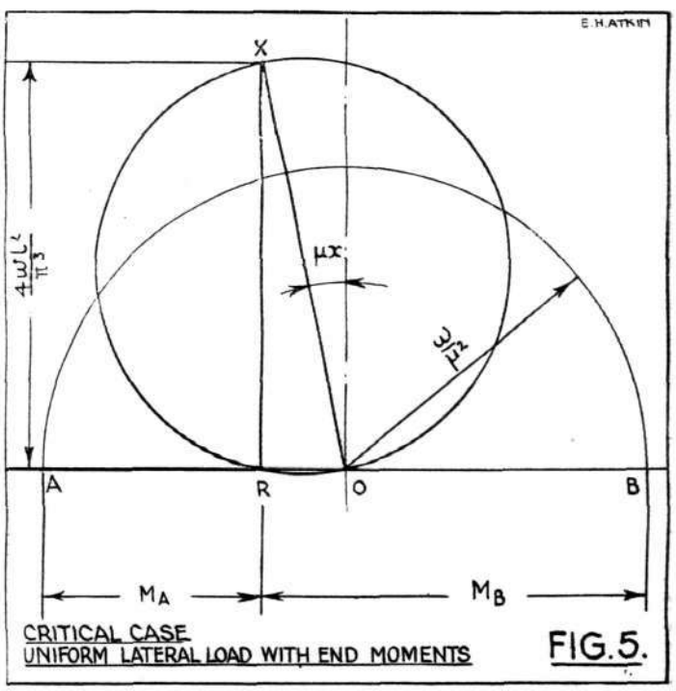
where $m_A = M_A - \frac{w}{\mu^2}$

and $m_B = M_B - \frac{w}{\mu^2}$

$$\therefore \left[\left(M_A - \frac{w}{\mu^2}\right) + \left(M_B - \frac{w}{\mu^2}\right)\sec\alpha\right]\cot\alpha = AX.$$

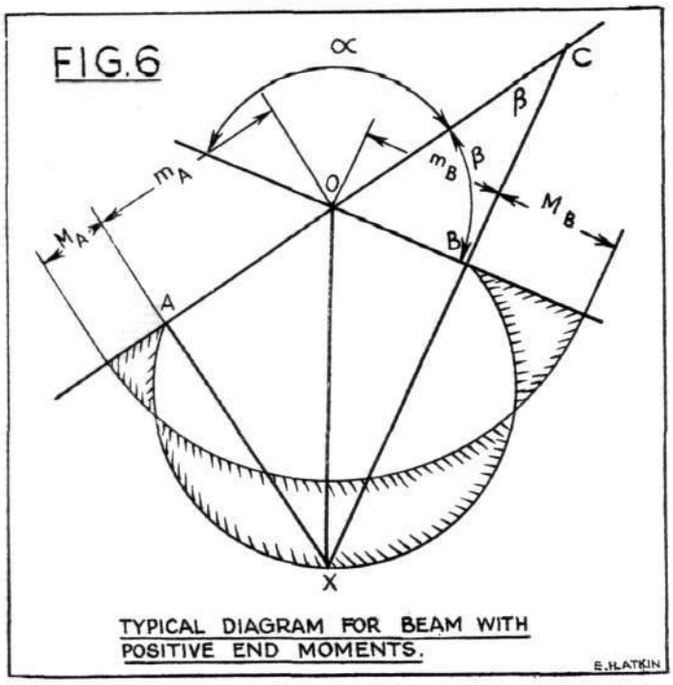
Our problem is to find the value of AX when $\beta = 0$ ($\alpha = \pi$) consistent with the condition $\frac{L}{2}(M_A + M_B) = \frac{w}{\mu^2}$.

Assume that $w$, $M_A$, $M_B$, and P increase together so that




CRITICAL CASE
UNIFORM LATERAL LOAD WITH END MOMENTS

FIG.5.




TYPICAL DIAGRAM FOR BEAM WITH POSITIVE END MOMENTS.

their mutual ratios remain unaltered, $\frac{w}{\mu^2}$ is, therefore, constant and, if at some point $M_A = M_A'$ and $M_B = M_B'$ then at any other point $M_A = \left(\frac{\alpha}{\alpha^1}\right)^2 M_A'$ and $M_B = \left(\frac{\alpha}{\alpha^1}\right)^2 M_B'$. Where $\alpha^1$ is the angle of the diagram when $M_A = M_A'$, $M_B = M_B'$.

Using the approximate values for cos $\beta$ and sin $\beta$ and putting $\beta = \pi - \alpha$, the expression for AX becomes

$$\left[\left\{\left(\frac{\alpha}{\alpha^1}\right)^2 M_A' - \frac{w}{\mu^2}\right\} + \left\{\left(\frac{\alpha}{\alpha^1}\right)^2 M_B' - \frac{w}{\mu^2}\right\}\right] \frac{1}{(\pi - \alpha)}$$

If $M_A + M_B = 2\frac{w}{\mu^2}$ when $\alpha = \pi$ this expression becomes indeterminate.

Differentiating according to the general rule for such indeterminate expressions

$$-2\left(\frac{\alpha}{\alpha'^2} M_A' + \frac{\alpha}{\alpha'^2} M_B'\right)$$

$$= -\frac{2}{\alpha}\left\{\left(\frac{\alpha}{\alpha^1}\right)^2 M_A^1 + \left(\frac{\alpha}{\alpha^1}\right)^2 M_B^1\right\}$$

which when $\alpha = \pi$ and $M_A + M_B = 2\frac{w}{\mu^2}$

$$= -\frac{2}{\pi} \cdot \frac{2w}{\mu^2}$$

which since $\pi = L\mu$ · gives

$$AX = \frac{4\, w\, L^2}{3} \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Having calculated AX (= RX in Fig. 5) from this formula the diagram can be completed.

More complicated cases can be dealt with in a similar manner, but enough has been said to convince the reader of the existence of this case and so to prepare him for the next section on continuous beams.

If the critical case did not exist the theory of the instability of continuous beams would be a farce.

### (6) Instability Criteria for Continuous Beams

The instability of continuous beams, with changes in distributing load, concentrated loads, and changes of moments of inertia between the supports, presents a problem of great practical difficulty.

The whole subject of instability is, of course, bound up with the general theory of continuous beams, and it is impossible to give here an account which has any pretensions to completeness.

We shall, therefore, confine ourselves to continuous beams comprising two bays, and show how the polar diagram can be used to elucidate the problem.

In this case the bending moment at the intermediate support is the only unknown quantity, and the vanishing of its coefficient in the equation which determines it is the criterion of instability.

Hence our first problem is to determine this coefficient. R. and M. No. 1233 shows us how to do this and provides us with the result (6).

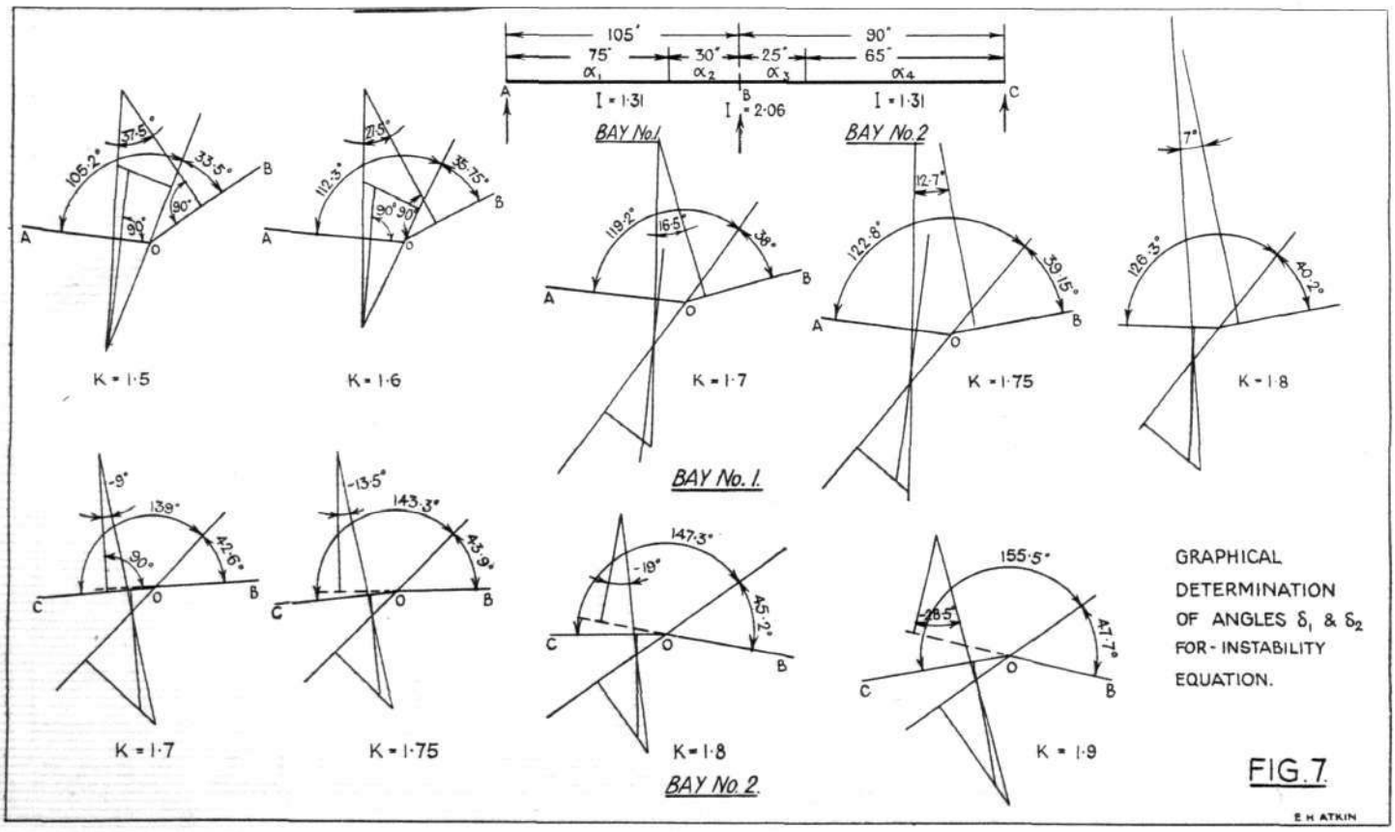



FIG. 7.

TABLE OF VALUES FOR BAY NO. 1.

| K | 1·5 | 1·6 | 1·7 | 1·75 | 1·8 |
|---|---|---|---|---|---|
| $\mu_{BR}$ | 0·01953 | 0·02082 | 0·02215 | 0·0228 | 0·0234 |
| $\alpha_1$ | 105·2° | 112·3° | 119·2° | 122·8° | 126·3° |
| $\alpha_2$ | 33·5° | 35·75° | 38·0° | 39·15° | 40·2° |
| $P_1$ | 23,620 | 26,900 | 30,350 | 32,200 | 34,050 |
| $\delta_1$ | 37·5° | 27·5° | 16·5° | 12·7° | 7° |
| $\cot \delta_1$ | 1·3032 | 1·9209 | 3·376 | 4·437 | 8·1443 |
| $\frac{\mu_{BR}}{P_1} \cot \delta_1$ | $0·1078 \times 10^{-5}$ | $0·1485 \times 10^{-5}$ | $0·2465 \times 10^{-5}$ | $0·314 \times 10^{-5}$ | $0·56 \times 10^{-5}$ |
| $\frac{1}{P_1 l_1}$ | $0·0403 \times 10^{-5}$ | $0·0354 \times 10^{-5}$ | $0·0314 \times 10^{-5}$ | $0·0296 \times 10^{-5}$ | $0·028 \times 10^{-5}$ |
| $\frac{\mu_{BR} \cot \delta_1}{P_1} + \frac{1}{P_1 l_1}$ | $0·1481 \times 10^{-5}$ | $0·1839 \times 10^{-5}$ | $0·2779 \times 10^{-5}$ | $0·3436 \times 10^{-5}$ | $0·588 \times 10^{-5}$ |

Note :—$P_1 = 10{,}500\ K^2$

The coefficient of $M_B$ is seen to be

$$\frac{\mu BR}{P_1} \cot \delta_1 + \frac{1}{L_1 P_1} + \frac{\mu BL}{P_2} \cot \delta_2 + \frac{1}{L_2 P_2}$$

For instability this expression must equal zero.

In order that the reader may use this expression without reference to other sources of information, the symbols used will now be defined.

The beam consists of two bays, AB and BC.

$\mu BR$ is the value of $\mu$ immediately to the right of B.
$\mu_{BL}$ is the value of $\mu$ immediately to the left of B.
$P_1$ and $L_1$ refer to the bay to the right of B.
$P_2$ and $L_2$ refer to the bay to the left of B.

To understand the meaning of $\delta_1$ imagine the polar diagram of the bay AB: Commence constructing the diagram from the end A: the angle between the final adjusted locus and the perpendicular to OB is the angle $\delta_1$. Similarly, starting from C we define $\delta_2$.

If each bay has a constant moment of inertia, the above expression becomes (neglecting a numerical factor)

$$\frac{L_1}{I_1} \phi(\alpha_1) + \frac{L_2}{I_2} \phi(\alpha_2)$$

the well-known coefficient of MB in the Berry equation where $\phi(\alpha_1)$ and $\phi(\alpha_2)$ are the Berry Functions. In this case, the polar diagram offers no advantages because any case may be examined by means of the graphs given in A.P. 970, Appendix Ic.

One very useful inference from this is that concentrated loads, arbitrary and moments, and the changing of the magnitude of the distributed load in a bay have no effect whatever on the stability of a continuous beam (and incidentally, a single one).

We shall now find the instability point in the following case (see Fig. 7).

It has been seen that the lateral loads do not affect the problem. All we need are the end loads and the properties of the beams. The assumption is that the end load in bay No. 1 is 10,500 lb. when the end load in bay No. 2 is 19,000 lb. and that these end loads, as they increase, remain in a constant ratio to one another. In real life this usually happens.

Consider Bay No. 1 first.

$$\mu_{AL} = \sqrt{\frac{10{,}500}{3 \times 10^7 \times 1·31}} = 0·01635$$

and

$$\mu_{BR} = \sqrt{\frac{10{,}500}{3 \times 10^7 \times 2·06}} = 0·01302$$

$\therefore\ \alpha_1 = 75 \times 0·01635 \times 57·3 = 70·2°$
and $\alpha_2 = 30 \times 0·01302 \times 57·3 = 22·35°$

giving a total $\alpha$ angle of 92·55°.

This is much too small. Take a series of multiples each K times $\alpha_1$ and $\alpha_2$ with corresponding values for $\mu_{BR}$ and $P_1$.

$\delta_1$ can be determined from the values so obtained either by drawing skeleton polar diagrams or by calculation from a representative polar diagram.

We shall choose the former method because it shows so clearly the way in which $\delta_1$ varies and how its sign changes. The set of skeleton diagrams is shown in Fig. 7.

*(To be concluded.)*

# TECHNICAL LITERATURE

## SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

These Reports are published by His Majesty's Stationery Office, London, and may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through any Bookseller.

ON THE EDDY SYSTEM IN THE WAKE OF FLAT CIRCULAR PLATES IN THREE DIMENSIONAL FLOW. By T. E. Stanton and Dorothy Marshall. Work performed for the Department of Scientific and Industrial Research. R. & M. No. 1358. (Ae. 489.) (11 pages and 10 diagrams.) January, 1930. Price 1s. net.

The method of colour bands for revealing the characteristics of the motion of water was first used by Osborne Reynolds some fifty years ago in the determination of the critical velocity at which the streamline motion in parallel pipes broke down. Since that time several attempts have been made to use the same method for the study of vortex motion, but, owing apparently to lack of sufficient precautions to ensure that all internal motions in the reservoir supplying the stream had disappeared before the experiments were made, the success achieved has not been as great as might have been expected.

The present experiments were made in a 1½-in. by 1½-in. vertical water channel in which steady motion could be maintained over a considerable period of time for a large head of water and a long pipe to give the supply. Brass circular plates of diameters ranging from 3 mm. to 6 mm. were supported symmetrically by a vertical spindle with their axes normal to the direction of flow. A stream of coloured fluid of the same density as the water supplied through the vertical spindle was led to the edge of the circular plates and then passed into the wake. The characteristics of the eddy systems set up were investigated.

At speeds lying between a well-defined upper limit and a lower limit well above that corresponding to a state of flow in which the inertia terms are negligible, a permanent vortex ring was observed at the back of the plate. When the speed exceeded the upper limit, the substance of the ring was discharged down stream in a series of vortices of definite pitch and periodicity, the characteristics of which were recorded photographically.

THE BEHAVIOUR OF SINGLE CRYSTALS OF BISMUTH SUBJECTED TO ALTERNATING TORSIONAL STRESSES. By H. J. Gough, M.B.E., D.Sc., and H. L. Cox, B.A. R. & M. No. 1432. (16 pages and 18 diagrams.) December, 1930. Price 1s. 6d. net.

The experiments described in the present paper were undertaken as an item in the general research, in progress at the National Physical Laboratory, into the mode of deformation of large single metallic crystals under the action of repeated stresses.

The primary object of the experiments was to obtain information as to the relative importance in relation to the process of slip of the atomic densities on the slip plane and in the slip direction. Previous experiments on other materials indicated that, in general, slip occurs on the planes of maximum atomic density in the directions of closest atomic packing; but in the case of iron, the slip direction alone is thus determined, the slip plane not being clearly defined. Bismuth appeared to be a suitable material for experiments to determine the relative influence of planer and linear atomic densities, since the face-centred rhombohedral lattice, in which it crystallizes, is characterised by the property that the planes of maximum density do not contain any of the lines of maximum density and thus the process of slip cannot conform to both criteria.

Neither of the specimens deformed by slip and no definite slip bands were

observed throughout the tests. No surface markings of any sort parallel to the traces either of the planes of maximum atomic density or of the plane containing the three lines of maximum density were recorded. Numerous twins, on one of the three possible twinning planes, were formed on each specimen during the course of the tests.

The first specimen fractured in the test portion by complete cleavage parallel to the plane perpendicular to the trigonal axis of the crystal. The fracture was of a brittle type and had no appearance of fatigue failure.

The second specimen also failed by cleavage; but in addition fatigue cracks were formed which had no connection with the main cleavage. These cracks followed in the main the directions of the planes perpendicular to the trigonal axes of the original crystal and of the twinned structures and indeed constituted the main evidence for the positive identification of some of the more ragged bands as twins.

### THE BEHAVIOUR OF A SINGLE CRYSTAL OF ALUMINIUM UNDER ALTERNATING TORSIONAL STRESSES WHILE IMMERSED IN A SLOW STREAM OF TAP WATER. By H. J. Gough, D.Sc., and D. G. Sopwith, B.Sc.Tech. R. & M. No. 1433. (30 pages and 48 diagrams.) September, 1930. Price 2s. 6d. net.

The experiment here described forms part of a general research into the characteristics of the fatigue of metals when surrounded by a substance other than air (when the substance is of a corrosive nature, the term "corrosion-fatigue" is in common use). Considerable information is now available regarding the corrosion-fatigue strengths of metals and alloys and of the partial or complete arrest of corrosion-fatigue action by the use of inhibitors. But the changes in microstructure resulting from corrosion-fatigue appear to have been entirely neglected. It was considered that an experiment in which the specimen consisted of metal in its simplest form namely the single crystal, was a suitable form in which to commence a metallographic investigation. The present paper describes observations made on the change in structure of a single crystal of aluminium, subjected to cycles of reversed torsional stresses, while immersed in a slow stream of ordinary tap water.

The main characteristics of the failure of the specimen were three-fold—(i) general pitting attack; (ii) local attack; and (iii) preferential corrosion on the site of previously formed slip bands.

The first resulted in the formation of a large number of corrosion pits at all parts of the surface. When first observed their "frequency" or density of population was of the order of 10 million pits per square inch of surface area. No fatigue cracks radiating from these pits were observed, although it appears possible that had not the specimen fractured through other causes, fatigue failure would have set in—at some later stage—due to pit formation.

Several large corrosion pits—of a much greater size than the pits due to general attack—were also observed, particularly in the early stages of the test.

This was the factor which was almost entirely responsible for fracture of the specimen. Due to this cause were developed a large number of very long cracks (40 or 50 at least) and a multitude of small cracks. The cracks were in every case parallel to the traces of the operative slip-planes, changed direction with the change in slip-plane, and were most thickly concentrated in the region of maximum resolved shear stress intensity; they were thus directly related to the crystalline structure of the specimen and to the applied stressing system.

These experiments of course throw no light on the behaviour of an inter-crystalline boundary under corrosion-fatigue conditions; an experiment has been designed with this further object in view.

### HOT WIRE AND SPARK SHADOWGRAPHS OF THE AIRFLOW THROUGH AN AIRSCREW. By H. C. H. Townend, B.Sc. R. & M. No. 1434. (10 pages and 13 diagrams.) September, 1931. Price 1s. 3d. net.

In the study of the motion of gases or of disturbances occurring in them, one of the methods which have been used to make the motion visible is based upon local variations of refractive index which exist or can be produced in the fluid itself. In a previous paper,* a modification of the latter method has been described whereby the stream lines appropriate to the steady motion of air past a body mounted in an airstream could be rendered visible. The method consists in placing a grid of fine wires electrically heated in front of the body, and casting shadows of the bands of hot air produced by them on to a screen.

Work of a similar kind has also been done in Japan†, but in this case a broad stream of hot air was produced large enough to envelope body completely. Photographs were then taken by both of the above methods of the motions of this volume of heated air in passing round the body. Their results applied mainly to the eddying flow associated with bluff bodies.

In the present paper experiments are described in which the hot wire method has been applied to the periodic flow through an airscrew and has been further developed by replacing the hot wire by a periodic electric spark, the shadow of which consists of a series of dots and thereby enables the velocity and direction of the flow to be mapped out. By interrupting the illuminating beam with a stroboscope the shadows are brought to rest and records can be made from which measurements can be obtained.

The frequency of the sparks has been taken as high as 1,300 per second, and could probably be increased considerably if necessary. Their shadows have been observed with ease up to a wind speed of 30 ft./sec.

By interrupting the illuminating beam of light with a stroboscope driven by the screw, and by changing the phase relations between them, the motions of individual small masses of air could be observed at any point in the field. Arrangements were made to change the phase relation between the screw and the spark generator while the stroboscope remained synchronised with the latter; the general motion of the dots downstream was thereby arrested, while the deviations produced by the screw were revealed. The making of shadowgraphs was facilitated by using a differential stroboscope arranged to give isolated exposures of about 1/6,000 sec. every hundred revolutions of the screw.

A more complete examination of the flow round an airscrew is to be made using a larger and more accurate screw mounted in a proper wind tunnel.

* R. & M. 1349. "On Rendering Airflow Visible by Means of Hot Wires." H. C. H. Townend.

† "Kinematographic Study of Aeronautics, Terazawa, Yamazaki and Akishino." Reports of Aeronautical Research Institute, Tokyo. Vol. 1, No. 8, September, 1924.

### ON A DETERMINATION OF THE PITOT-STATIC TUBE FACTOR AT LOW REYNOLDS NUMBERS, WITH SPECIAL REFERENCE TO THE MEASUREMENT OF LOW AIR SPEEDS. By E. Ower, B.Sc., A.C.G.I., and F. C. Johansen, M.Sc. R. & M. No. 1437. (28 pages and 11 diagrams.) August, 1931. Price 1s. 6d. net.

Of the numerous instruments that have been devised for the measurement of the speed of flowing gases, the pitot-static combination alone has proved itself suitable for use as a standard. It owes its superiority in this respect mainly to the fact that its calibration factor has been found to be constant over a large range of Reynolds number and is affected only by mechanical damage of a kind that can easily be detected by cursory inspection. A single calibration therefore endures throughout the life of the instrument. For this reason the combined pitot-static tube, in one or other of a few types differing only in unimportant details, has been universally adopted as a standard, and although in many circumstances other apparatus or instruments may be more conveniently used for measuring gas-flow, the calibration of such apparatus or instruments has always ultimately to be referred to pitot-static measurements.

No direct calibration of the British standard has hitherto been made for air speeds of less than 20 feet per second. There is no *a priori* justification for the assumption that the factor will retain its value of unity for the lower speeds.

By the use of a new sensitive manometer the pressure corresponding to an air speed of 2 feet per second could be observed to an accuracy of 1 per cent., while the accuracy reached 0·1 per cent. at about 6½ feet per second. The swirl in the tunnel was measured by means of hot-wire anemometers, and very good agreement was obtained between the values determined at different times and with different wires.

A definite scale effect was found on the static side of the pitot-static combination, which causes the factor to rise somewhat below speeds of 18 feet per second and to drop sharply below 3 feet per second. Below 15 feet per second there is an unstable region in which the value of the factor is uncertain, but mean values have been obtained which are considered accurate to ± 1 per cent. down to 4 feet per second. Hence they enable air speed down to this lower limit to be measured by means of the standard pitot-static tube to an accuracy of ± 0·5 per cent.

The research has provided data which enable the standard pitot-static tube to be used, in conjunction with the new sensitive manometer, as a standard instrument for the measurement of low air-speeds. The accuracy on speed will be ± 0·5 per cent. down to 4 feet per second.

### "THE STRESSES IN A WIRE WHEEL UNDER RIM LOADS." PART I. THE STRESSES IN A WIRE WHEEL WITH NON-RADIAL SPOKES UNDER RIM LOADS IN THE PLANE OF THE RIM. By Professor A. J. Sutton Pippard, M.B.E., D.Sc., and Miss M. J. White, B.Sc. R. & M. No. 1440. (19 pages and 23 diagrams.) May, 1931. Price 1s. 3d. net.

*Summary.*—It has been shown in two earlier papers* that the stresses in a radially-spoked wire wheel caused by a radial load on the rim can be obtained with considerable accuracy from a consideration of the case of a wheel having an infinite number of spokes. In the present paper a similar treatment is applied to the general problem of the wire wheel in which the spokes, instead of being radial, fall into two systems, those of one system being inclined at a constant angle to the radius and those of the second at the same angle to the other side of the radius.

Such a wheel differs from the radially spoked type in that it can resist not only radial loads, but those in any direction in the plane of the wheel. Solutions are therefore given for the stresses under radial and tangential rim loads acting separately: superposition of these solutions enables the stresses to be calculated when the load acts in any direction.

* "The Stresses in a Radially Spoked Wire Wheel under Loads Applied to the Rim." A. J. Sutton Pippard and W. E. Francis. R. & M. 1302. Ditto. Part II. Simplified formulæ and curves. R. & M. 1337.

### THE NORMAL ACCELERATION EXPERIENCED BY AEROPLANES FLYING THROUGH VERTICAL AIR CURRENTS. PART I: THE CALCULATION OF THE ACCELERATION EXPERIENCED BY AN AEROPLANE FLYING THROUGH A GIVEN GUST. By H. R. Fisher, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1463. (16 pages and 7 diagrams.) March, 1932. Price 1s. net.

Prof. B. M. Jones has pointed out what may be obtained from normal accelerometer records in flight through non-uniform vertical currents, the objects being to study the frequency of accelerations of various magnitudes and the forms of vertical currents. He suggests as a provisional assumption (1) that the aeroplane traverses the current without change of attitude or forward speed, and (2) that the change of current within its length can be neglected, in which case the acceleration satisfies a simple differential equation. To this approximation the acceleration experienced by any aeroplane in traversing a given vertical current distribution will be proportional simply to its speed divided by its wing loading if we assume that all aircraft have the same slope of lift curve.

Little experimental evidence is available on this point,* but in the meantime a few calculations have been made to examine the effects (1) of an aeroplane's stability characteristics and (2) of its length, in flight through vertical disturbances of simple mathematical form. One case taken is that discussed by Prof. Jones, namely, that in which the aeroplane passes from undisturbed air to a constant vertical current through a linearly graded band. On his assumptions the maximum acceleration will occur at the end of the band. Another case worked out relates to a vertical current distribution in the form of a hump. Something of this sort would probably be met in flying across a cliff (above its "shadow") with the wind at right angles to the cliff. The case of an abrupt or sharp edged-gust, has been examined for the sake of the light it throws on the details of the reactions between the aeroplane and the moving air.

The acceleration of a given aeroplane in a given gust is not proportional to the speed, as the simplest assumptions suggest, but increases more rapidly than the speed.

The assumption of constant attitude and speed gives in some gusts maximum accelerations over 30 per cent. too small.

In a gust which increases to a maximum and then decreases, the ratio of the maximum acceleration to the maximum gust depends chiefly on the distance in which the maximum acceleration is reached and little on the exact form of gust.

* See, however, N.A.C.A. Technical Note No. 374 (Ref. 2). Table 1 shows the effects of flying different aeroplanes at different speeds through a supposed constant bump; and R. & M. 1441 (Ref. 3).

# AIR TRANSPORT

## THE NEW PERSIAN GULF ROUTE

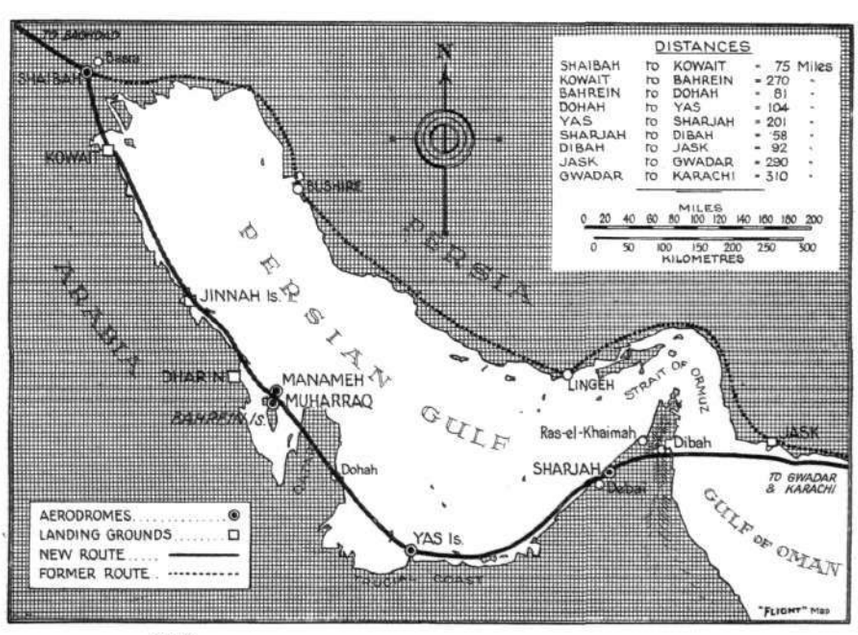
NEXT month the agreement with the Persian Government, which allowed British civil aircraft to use aerodromes along northern shore of the Persian Gulf, comes to an end, and the Government of the Shah is not willing to renew it. Imperial Airways have, accordingly, been obliged to lay out a new route along the Arabian shore of the Gulf, and this will be ready for operation next month. Despite the nuisance and expense of making the change, there is a general feeling of relief that this great British airway will no longer be dependent on the goodwill of the Persian Government. The Arab rulers on the southern side are people with whom it is much easier to deal. Our relations with Ibn Saud, the King of the Hedjaz, are quite cordial, and it was mainly due to British diplomacy that King Faisul of Iraq recently consented to meet the old rival of his house on amicable terms. The Indian Government has for long maintained very friendly relations with the various other independent sheikhs, great and small, on the Arabian coast and the neighbouring islands.

The question of using flying boats along the route was carefully considered by Imperial Airways, and they were able to consult with No. 203 (Flying Boat) Squadron of the Royal Air Force, which is stationed at Basra, and whose "Rangoon" boats are constantly touring the waters of the Gulf up to Karachi. They naturally have a good deal of experience of the conditions there. It seems that along the whole of the Trucial Coast, namely that stretch of coast from, roughly, Yas island to the peninsula opposite the Straits of Ormuz, there are only two places which would make satisfactory harbours for flying boats. These are Ras-al-Khaimah and Debai, both of which are marked on our map. The local sheikhs, though quite friendly, are rather conservative gentlemen, and fear that their people would not be too enthusiastic about the advent of such a modern innovation as a regular air service. Then the Sheikh of Sharjah made an offer of a land aerodrome in his territory, and this practically settled the matter, and determined that the new route should be a landplane route. Thoughts of the "Kent" were abandoned, and it was decided to lengthen the range of the Handley Page 42. Extra tanks were fitted in all four machines to hold an extra 125 gallons of petrol and extend the range to 620 miles.

The Arabian shore of the Persian Gulf is flat and shelving, in great contrast to the high rugged mountains on the Persian shore. The desert is composed of a gravelly sort of sand, and is flat and hard. There are numerous islands off the coast—a great advantage to the airway—and they, too, are mostly flat and sandy. In times of bad visibility it is sometimes rather hard to make out an island from the air. Over Arabia the wind blows from the north-west for about nine months of the year, and it drives the dust up into the air to a height of about 10,000 feet. Hence the occasional bad visibility. On the other hand, the Arabian shore is a kindly one, in the sense that it would be possible to put an aeroplane down safely on most parts of it, and on most of the islands. Generally speaking, it would be preferable to land on an island in case of need, and the King of the Hedjaz and most of the sheikhs would prefer that this should be done. Such an occurrence, of course, is not a probable one with four-engined machines, but if it should happen we may feel sure that the "Rangoons" from Basra would soon fly to the spot and bring what help was needed. The Imperial Airways machines will probably fly just off the coast for most of the way, and this will add to the attractions of the journey. Unadulterated desert, we believe, gets wearisome to the air traveller after a few hours, but water always looks charming from the air, especially when there are plenty of islands. The air is calm over the sea—a relief after the bumps which are too often felt over the desert between Galilee and Basra. The Gulf is not a stormy sea, though it is a windy one. The north-west wind over Arabia will help the aeroplanes for a great part of their journey to Karachi, and will equally hinder them on the return trip. The Imperial Airways time-table has been arranged to discount this.

The new journey will be as follows (see accompanying map). The present aerodrome of Basra is Shaibah, a R.A.F. station, just outside the city. The first part of the flight is over the deltaic land of the combined Tigris and Euphrates, the chief mouth of which is called the Shatt-ul-Arab. The machine strikes the open Gulf at Kowait, after a flight of 75 miles. Kowait is the second largest city in all the Arab countries, and the Sheikh of Kowait is a very friendly person to the British. There is a landing ground at Kowait, but the place is not a scheduled halt. To the south of this lies a stretch of territory more or less subject to the King of the Hedjaz. Two landing grounds for emergencies have been laid out on islands off this coast, namely Jinna and Tarut, the latter being also known as Darin. The aeroplane lands for lunch at the large island of Bahrein. This island is the centre of a group, which are under the protection of the Government of India. Bahrein is the centre of a large pearl fishery. The capital is Manamah, and there is an aerodrome there. A second aerodrome has been constructed on the island of Muharraq. The stop at Manamah for lunch is sure to be an interesting break in the journey, for it is a pleasant place, possessed of many vineyards and natural wells which yield water of a temperature of 84 deg. all the year round. After lunch the journey is resumed. The route soon crosses the low-lying peninsula of Qatar, and then enters the great bay at the southernmost end of the Gulf. Boats would probably fly across the north of this, but landplanes keep nearer to the coast, making for Yas island, where there is a landing ground. Then the course turns north-eastward to Sharjah, where the machine lands for the night. A rest house is being built there, 1½ miles from the town. Sharjah is the seat of a British political agent, an Arab named Khan Bahadur Isa, a wealthy merchant who is well known along the Trucial Coast.

Next morning the scenery changes, as the aeroplane approaches the range of mountains which runs up the peninsula. At the northern extremity these mountains rise to 6,000 feet, and to the south they are even higher, but there is a pass of about 3,000 feet between Sharjah and Dibah through which the aeroplane flies. Then it strikes out across the open Gulf for Jask, but keeps three miles off the coast so as not to encroach on Persian territorial rights. It follows the coast until it reaches Gwadar in British Baluchistan (a flight of 340 miles non-stop from Sharjah), and from there on political considerations need not worry it; it follows the well-known route to Karachi.



# AIRPORT NEWS

## CROYDON

THE departure of air liners is a common enough event at Croydon, yet one that never fails to be interesting. The different passengers, the pilot who is taking the machine, the prevailing weather conditions and the take-off, all go to make a departure a sight worth witnessing. I suppose it was for these reasons that I decided to watch the *Silver Wing* leaving the other day, and for those who are not yet familiar with the airport routine, here is what I saw. Walking out of the main hall through the departure doorway, past the Immigration office and along the passage, I came to the door which opens on to the tarmac, and which has frequently been referred to by various writers as the Gateway to the World. Directly in front was the Imperial Airways 42-seater air liner, which had been drawn up to a position where the cabin door was in line with the doorway of the building. Placed against the doorway of the cabin were some teak steps with polished brass hand rail, which would have done credit as the companionway of a battleship. The upper wing of the machine being only a few feet from the building this helped to make the 'plane appear to be nearer, almost like stepping from a platform on to a train. Imperial Airways and the K.L.M., I am told, race everyday to gain this most advantageous position. Each company realises that it is the attention to the small details of the service that creates a mark of distinction. Each of these machines leave at the same time, and the uniformed staff of both companies tends to give the effect of what a railway station might look like if run by naval officers. After the engines had been run up, the passengers began to embark, the cabin door was then securely closed, steps and chocks removed, and as the minute hand of the clock reached 12.30 the stand-by pilot blew a whistle for the departure signal from the control tower—and the *Silver Wing* was on its way to Paris.

One meets some very remarkable people at Croydon. I noticed amongst those who had come to give their friends a send-off a little girl accompanied by her mother, although only 2½ years old she had the knowledge of three languages.

Mr. Comper arrived on Tuesday afternoon on his way to Hooton in his "Comper Swift." The weather was so unfavourable, however, that he decided to continue his journey the next day. Mr. Comper has been on a visit to Geneva, where he has been arranging agencies, returning by Frankfort, Cologne and Brussels.

Herr Kronfeld, the well-known gliding pilot who holds the altitude and distance records, arrived in the German air liner D.2500 from Hannover—he left later for the Hanworth Club, where he is staying.

By far the most interesting event of the week was the departure of the Prince of Wales last Wednesday to Copenhagen. Numbers of visitors to the fair have followed the Prince's example of travelling by air. The unusual number of passenger bookings caused the Royal Dutch Airlines to place one of their largest air liners on service on Thursday morning. In addition to passengers for Rotterdam and Amsterdam, there were sixteen passengers to Copenhagen, including the Rt. Hon. Lord Ritchie of Dundee and a party from the Port of London Authority. There was also a considerable increase in the number of newspapers and mails. At the last moment it was discovered by the London office of the British Industries Fair, Copenhagen, that they had sent everything to the exhibition except a Union Jack, which was required for the opening ceremony—this was also despatched in the air liner.

Prince George is expected to fly by this service as far as Malmo next Friday, on his way to meet the Prince of Wales in Stockholm.

The body of the French pilot, M. Gustave Demeuldre, who lost his life in the crash at Selsdon, was conveyed by air to Paris in a special machine of the Air Union.

As a result of the weather on Friday, the worst experienced for a considerable time, ten out of a total of twelve air liners bound for Croydon were forced to land at different places between the coast and the Air Port. Two of the ten machines, however, ultimately managed to reach Croydon, one of them having previously landed at Marsden and the other at Lympne. A French pilot had almost reached Croydon when he found that his wireless had suddenly gone out of order and was forced to turn back. Amongst the passengers on the Imperial Airways 12.30 'plane from Paris, which was one of those to land at Lympne, was David Sandford, a four-year-old-boy who was travelling alone. This was his first trip in an aeroplane.

Aviation helped its own in the case of Mr. Hancock, of Surrey Flying Services, Ltd., who flew with a pupil to Hamburg. On their return journey they landed at Bremen to re-fuel. It was then discovered that their propeller was badly split. They wired S.F.S. for a new propeller at 2.30 in the afternoon and prepared for a few days' stay in Bremen. At 7 o'clock the next morning Mr. Hancock was awakened with the news that his propellor had arrived. It had been put on the German night freight machine leaving Croydon at 10 p.m., and had been transferred at Hannover in the early hours of the morning to a train for Bremen—Mr. Hancock and his friend were back at Croydon in the afternoon.

Total number of passengers for the week, 1,904 ; freight, 70 tons 15 cwt.

HORATIUS.

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## FROM HESTON

ON the 16th inst. Banco had an urgent charter to Pau (Pyrenees), and their "Puss Moth" left at 10 a.m., reaching Pau at 5.15 p.m., in spite of dense fog which was encountered up to the mouth of the Somme. On Monday, the 19th inst., five machines proceeded abroad—one to Cologne, one to Antwerp, one to Brussels, two to Berck. Banco had a special charter to Berck with "The Spider," Capt. Barnard returning the same day to Heston with three passengers.

Wednesday, September 21, saw Capt. J. G. Sandie, M.C., on leave from the Sudan, qualify for his "A" licence at the Airwork School of Flying. Mrs. Spencer Cleaver left for Paris in her "Puss Moth." Herr Kirsch arrived at 1.10 p.m. on the 22nd inst. from Aachen, where he left at 10.20 a.m. with a new Pobjoy "Klemm" which had been ordered by Sir John Carden, Bt.

On Saturday, September 24, the Director of Civil Aviation, Col. F. C. Shelmerdine, the Lord Mayor of London, accompanied by the Lady Mayoress and Sheriffs of the City, left Heston by air in the Spartan "Cruiser," piloted by Col. Strange, and the Westland "Wessex," escorted by five Wapitis of No. 600 (City of London) Squadron Auxiliary Air Force, to attend the Essex Air Pageant at Romford. They were followed by Capt. Ledlie, piloting the Personal Flying Services' Junkers, with "The Flying Family" as passengers. Later in the day Capt. Ledlie brought Mr. and Mrs. Hutchinson, with their two children, back to Heston, and, after a quick tea, left for Plymouth, where they are to join a liner for the United States.

On Saturday, October 8, an Air Pageant is being held at Heston in celebration of the Borough Charter granted to Heston and Isleworth. The Pageant will be opened at 2.30 p.m. by H. J. Nias, Esq., M.B.E., J.P., the Charter Mayor, taking the air, piloted by Capt. V. H. Baker, the machine will be looped and Mr. Nias will fire off a Verey light. An interesting programme has been compiled and already many tickets have been sold to Heston and Isleworth inhabitants. When the Charter is handed over by the Duke of Gloucester on October 3, a flight of aeroplanes is being sent from Heston Airport to fly overhead during the ceremony.

On Sunday, September 25, two machines proceeded abroad—one to Düsseldorf and the other to Aachen. Airwork School of Flying kept up a steady flow of instruction, including a cross-country flight by Capt. Ferguson with a pupil for a navigation lesson. Mr. R. L. Malone, of the London Insurance Brokers, took delivery of a new "Spartan Arrow" from Henlys, Ltd. Capt. Ledlie, of Personal Flying Services, Ltd., left during the afternoon in the Junkers with two passengers for Berck.

Always first with innovations, Airwork, Ltd., have now arranged for spare engines to be held by the Service Department ("Gipsy I," "Gipsy II" and "Gipsy III"), so that private owners requiring their engines overhauled do not have to cease their flying activities while the engines of their machines are out of action.

# AIRISMS FROM THE FOUR WINDS

**" Graf Zeppelin "**

THE German airship *Graf Zeppelin*, which left Pernambuco, *en route* from Rio de Janiero, for Germany on September 18, reached Friedrichshafen at 9.30 p.m. on September 21, having crossed the Atlantic from Brazil in the record time of 67½ hr. She left Germany again for Brazil on September 26.

**Bertram and Clausemann's Seaplane Salved**

THE Junkers seaplane in which Capt. Bertram and Herr Clausemann were forced down last May on the N.W. coast of Australia, has been salved and flown to Broome, Western Australia.

**Australian Airwoman's Escape**

MRS. BONNEY, the first Australian woman pilot to fly round Australia, had a narrow escape on September 21 when her machine came into collision with another 2,000 ft. above Benalla, Victoria. Both machines managed to land safely.

**Proposed Flight over Mount Everest**

AN expedition, with the object of flying over Mount Everest (29,000 ft.) to secure photographs and data of scientific and geographical interest, is being organised by Col. P. T. Etherton and Col. L. V. S. Blacker. The Marquess of Clydesdale, M.P., has been selected as the pilot for this venture, and he will be accompanied by a photographer in a British aeroplane with a special engine and equipment. The scheme has the support and assistance of the Air Ministry and the Mahrajah of Nepal.

**A Japanese Pacific Flight**

THREE Japanese airmen, Mr. Baba (pilot), Mr. Homma (navigator) and Mr. Inoshita (wireless), took off from Samushira on September 24 to fly to San Francisco in three stages via the Arctic.

**Do-X Developments**

SPEAKING at a reception given to him at Düsseldorf recently, Capt. Christiansen—Commander of the Dornier Do-X flying-boat—mentioned certain changes in the future construction of these machines. While the two machines of the Do-X class which had been delivered to Italy were, with slight exceptions, almost identical with the original ship, the next flying-boat to be constructed would show considerable alterations. The six twin engines, hitherto mounted high up above the wing, and one of the striking features of the Do-X, were to be removed to inside the wing. By this means it was expected to reduce the head resistance and to increase, with approximately the same engine power, the speed of the boat to much in excess of its present speed of about 106 miles an hour. By other constructional improvements and the use of better material it is intended to save several tons in weight, which would improve the boat's pay load.

**A French Altitude Record ?**

THE French airman Signerin, on September 22, established a class altitude record for aircraft, carrying a load of 500 kilos, by reaching 34,384 ft.

**Von Gronau in China**

HERR VON GRONAU, who is flying round the world in his Dornier " Wal " flying-boat, resumed his journey on September 23, flying from Kagoshima (Japan) to Shanghai.

**A Record Parachute Jump**

ASCENDING to an altitude of 7,300 m. (24,000 ft.) from Kiel on September 20, the German airwoman Frau Schröter jumped from the machine in her parachute and landed 28 min. later at Hohenberg, some 15 miles from Kiel.

**Safety of Three Engines**

As a sidelight on the Essex Aviation Meeting, reported in this issue, we quote the following letter:—

" As an interesting sidelight on the ' multi-engine argument ' *versus* modern reliability of motors, etc., I don't know whether any of your people noticed our departure from Romford yesterday in the ' Wessex ' ?

" Just after taking off, and at about 150 ft. over that sticky little wood at the bottom end of the aerodrome, our starboard engine seized solid without warning. If we had been in a single-engined, and probably a twin-engined job, they would still be picking the bits of us from out of the branches: as it was, of course, we proceeded comfortably enough to Heston on the remaining two engines.

" An interesting proof to the Romford people and others of our contentions *re* 3-engined safety, wasn't it?—Yours sincerely, CHARLES BYRON, London, September 29."

**" Air Navigation "**

ON Thursday, October 6, the first lecture of the new session before the Royal Aeronautical Society will be delivered by Capt. Norman Macmillan, M.C., A.F.C., A.F.R.Ae.S., on " Air Navigation." The lecture, which will be illustrated, will be delivered in the Lecture Hall of the Royal Society of Arts at 6.30 p.m. Capt. Macmillan, who has had an unrivalled experience of flying in many parts of the world, has prepared a lecture for " the pilot who is not yet an experienced navigator." There are many who find themselves unable to understand the intricacies of navigation formulæ and who must be content with simplified methods of finding their way through the air. Capt. Macmillan discusses the *necessary* instruments and methods of navigation, and the natural aids for finding one's position or keeping a correct course across country. The lecture is one which will prove of very great value to all pilots and particularly to those who have taken to the air for their own pleasure.

**MODERNITY : A Gloster " Gnatsnapper," fitted with Rolls-Royce " Kestrel " engine, shows how amazingly " clean " an aeroplane can be made when evaporative cooling is employed.** (FLIGHT *Photo.*)

# "MAGNETOLOGICAL INEXACTITUDES"

*A great deal of misapprehension exists concerning the ordinary magnetic compass as used in aircraft. This article endeavours, in simple language, to explain the effect on the compass of flying on various courses. No attempt is made at technical explanations of these effects; their results only being dealt with, in a manner which, it is hoped, will enable them to be remembered easily*

**Compass Behaviour on Various Courses**

*On Northerly Courses . . . increased sluggishness*
*On Southerly Courses . . . . increased liveliness*
*On Easterly or Westerly Courses:*
*Deceleration or pitch up . apparent turn to South*
*Acceleration or pitch down . apparent turn to North*

THIS article is not going to be a learned dissertation upon the construction of the compass nor upon the reasons why it works, but it will, it is hoped, show to a certain extent why, to obtain full value from the compass in an aeroplane, the pilot should know rather more about its shortcomings than is usually the case.

The magnetic compass, particularly as used in the average type of light aeroplane, has quite a large number of bad habits, causing various errors which are known to come into operation under certain conditions and which can, therefore, if the pilot be fully conversant with their causes, be allowed for.

This may sound as if it is wished to paint the compass very black, but this is not case, for if these errors are known and understood then the compass may truthfully be said to be reliable and indispensable.

Wishing to demonstrate that under certain conditions the compass could definitely not be relied upon, advantage was recently taken of flying the "Moth" which the Phillips & Powis School at Reading have fitted up for instrument flying. The extra equipment added included a hood over the rear cockpit (allowing sufficient light to come through, so that the pilot could read his instruments without being able to see outside at all), a Reid & Sigrist turn and bank indicator and a pitch indicator from the same maker.

With the interest in instrument flying increasing, as it is every day, it is perhaps not inappropriate to connect the vagaries of the compass with that all-important branch of piloting, for it is certain that no one can learn to fly safely by instruments until he has a thorough knowledge of the behaviour of the compass under all conditions.

The errors entirely due to what one may call flying conditions are mainly two, the first being Northerly Turning Effect and the second Easterly and Westerly Speed Effect.

Northerly Turning Effect produces an appreciable lag in the compass during turns made in the sector enclosed between N.W. and N.E., and may even produce a movement in the compass giving a reading in the opposite direction to the correct one. Conversely, this same effect enlivens the compass during turns made anywhere between S.W. and S.E., so that although the movement indicated may be exaggerated in both magnitude and rate, yet this error really helps the pilots, especially when flying blind, through making the compass apparently more sensitive.

The errors on east and west are subdivided into those due to pitch and acceleration. On west or east, acceleration or a downward pitching movement shows an apparent swing towards north, while a deceleration or upward pitch shows a swing towards south.

By way of demonstrating these errors, a series of gentle turns made anywhere between N.W. and N.E. showed that on these bearings the compass was so sluggish that a far slower rate than the actual was shown, as the card always tended to turn with the aeroplane. The moral is obvious, and it is evident that on northerly courses a pilot could, were he flying blind and trusting to his compass alone, make steady turns all the time without being aware that he was doing so. The remedy is to fly straight by the Turn Indicator and only alter course when the compass has steadied down. The effect on southerly courses between S.E. and S.W. was, in the reverse way, equally obvious. The compass at all times being particularly responsive, showed the turn immediately and, as previously remarked, even exaggerated both the rate and the magnitude. This is due to the fact that while the compass card is really doing exactly the same thing as it did when the aeroplane was headed north, yet the effect is now reversed. On the northerly courses a turn towards, say, east, produces a movement, also towards east, of the north-seeking end of the compass card, thus negating to a certain extent the apparent amount of the turn; on southerly courses a turn towards east still produces a movement of the card in the same direction, but this time this movement is opposed to the head of the aeroplane and the apparent effect is, therefore, to make the compass more sensitive. It stands to reason, therefore, that southerly courses can be followed perfectly safely by compass alone when flying blind.

On an easterly heading the aircraft was held level at high speed; the throttle was then closed and the deceleration produced a swing of the card showing an apparent turn towards south; when the speed was increased there was an apparent turn towards north. On a westerly heading exactly the same effects were observed. These are due to the fact that the south-seeking end of the compass card magnetic system is heavier than the north-seeking end, with the result that it carries on relative to the aeroplane, when the latter is slowed down suddenly, and is left behind when the aeroplane is accelerated.

On the same heading the effect of pitch was tried, and it was found that when, at steady cruising speed, the nose of the aeroplane was pitched up the effect was the same as that produced by deceleration, in that the compass indicated a turn towards south, while, when the nose was pitched down, the turn indicated was towards north. These errors due to pitching are in part due to the alteration in speed occurring as a result of the pitch, and in part due to tilting of the compass card producing the same error as northerly turning effect.

It needs little thought to show that these easterly and westerly errors can easily produce conditions making blind flying almost impossible with safety unless they are known and anticipated. Imagine, for example, that during our flight we ran into cloud when heading east or west. We might well believe that we would be better off under the cloud and we should therefore throttle back and glide down underneath until we reached clearer atmosphere. Unfortunately for us, however—assuming that we have no Turn Indicator by which to fly—the act of throttling back makes us believe that we have started to turn towards south, while the downward pitch of our glide then makes it appear that we are turning the other way. The usual result is a hectic few moments spent trying to correct non-existent turns, a process which, if it does not result in spinning out of the cloud, at least shakes our faith in the compass. By sticking to the Turn Indicator, however, and then using the compass as a check, only when it has steadied down, accurate flying under all these conditions may be accomplished.

The modern compass, when it is treated reasonably, when all its vagaries are known, and when full allowance is made for them, is a fine piece of work, and many of the aspersions which have in the past been flung at it by irate pilots should in justice have been applied to themselves for not knowing more about the limitations of their equipment and the methods of counteracting those limitations.

C. N. C.

# THE INDUSTRY

## THE SHELL CARNET SCHEME

SHELL-MEX & B.P., LTD., have organised a scheme which will enable airmen on tour in this country or abroad to obtain supplies of Shell products on the strength of their signature alone, thus obviating the nuisance of carrying an excess of money in different currencies to pay for fuel. The Shell Carnet Scheme, as it is called, will take effect at practically every principal foreign aerodrome open to civil air traffic, also at Shell aerodrome service stations and on clearing Customs at a recognised Customs aerodrome in this country.

The carnets will be issued against a deposit, and the holders will contract to settle their accounts for supplies within 14 days of their presentation. Accounts are normally presented monthly, but those for long flights abroad will be presented as soon after the conclusion of the flight as receipts from all points are to hand. In the case of flights terminating abroad, arrangements can be made for accounts to be presented at any address outside this country.

The carnet is valid for one person and one aircraft only, ensuring that one cannot be charged for supplies not delivered to one's machine. A further measure of security is afforded by the carnet bearing a specimen of one's signature, which should correspond with that on the receipt, thereby effectually preventing the unauthorised use of one's carnet.

Shell carnets are issued for a fixed period; and an expiry date, after which no supplies will be obtainable on credit, is stamped on each card. The normal period of validity is one year, but a carnet for a shorter period can be issued should it be desired. A carnet can, of course, be renewed before the date of expiry, and if it is decided to make a tour which would keep you abroad beyond the date of expiry of your carnet, you could obtain its renewal before departure. Even if, by mischance, the carnet expired while you were abroad, the head office of the local "Shell" Company could issue another one.

The carnet, and the wallet containing it, remain the property of the company and must be returned to them on expiry. The company ask for a deposit against the issue of a Shell Carnet—the size of the deposit depending upon the amount of flying to be undertaken. A small deposit only is required for European touring, but, of course, a larger one would be required for anyone flying to, say, Kenya, as the sum outstanding at the end of their flight would be considerable. The usual trunk routes to Cape Town and Australia are fully covered under this scheme.

Although, to prevent any possibility of the misuse of the carnet, they only issue to private owners carnets valid for one machine, and issue a separate carnet for each machine if they have more than one, for the benefit of those connected with "the trade," *e.g.*, airline pilots and test pilots, they can arrange to issue carnets valid for "any aircraft." In this case the pilot is protected by having a specimen of his signature on the carnet which must correspond with the signature on the receipt which is signed for supplies uplifted at each point.

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## ANOTHER M.G. SUCCESS

BROOKLANDS, that home of aviation and motor car history, was once more the scene of an M.G. success on Saturday, September 24, when Mr. R. T. Horton and J. H. Bartlett, driving a supercharged M.G. Midget, won the 500 miles race organised by the British Racing Driver's Club at an average speed of 96.29 m.p.h. Mr. Horton's team also won the team prize, being the only team to complete the course. The performance of these small cars was really phenomenal, and Horton in the early part of the day was averaging 101 m.p.h., while G. E. T. Eyston, also driving an M.G. Midget, covered one or two laps at over 110 m.p.h. This race is probably the most gruelling test for racing cars that has ever been devised. The other team drivers were Messrs. G. W. Wright and W. M. Couper (83.15 m.p.h.) and Messrs. J. G. Low and G. H. Balmain (81.61). It is to be hoped that the lessons learnt by the engine designers of these cars may soon be turned to good account by the production of a light cheap aero engine.

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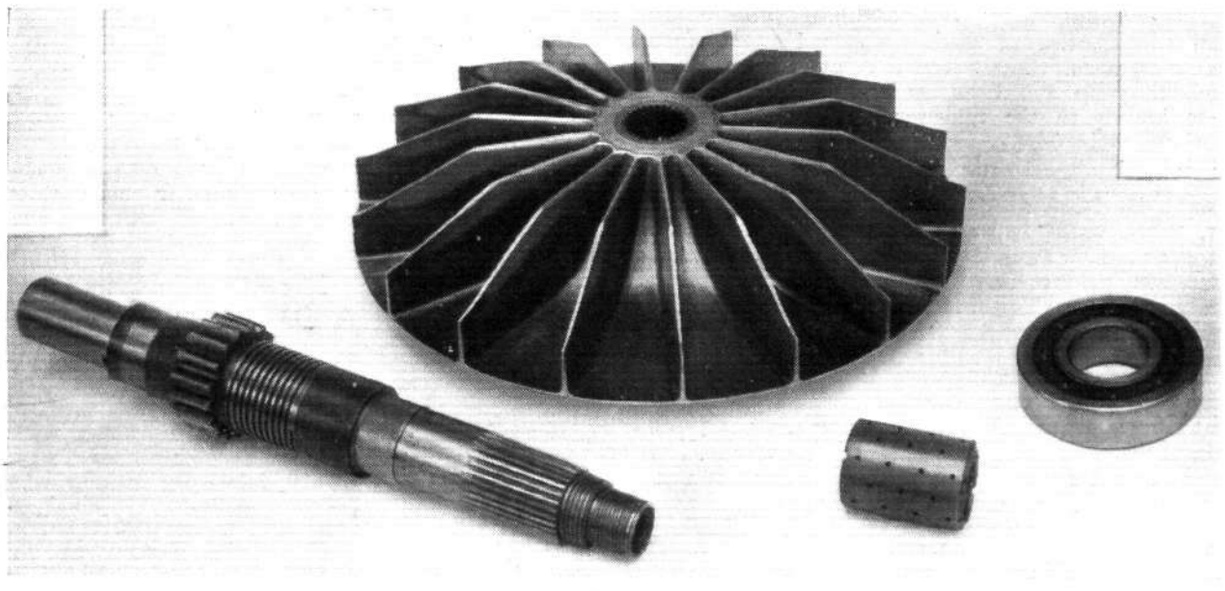
## "KLINGERIT 1000"

"KLINGERIT 1000" is a jointing for cylinder heads, exhaust gaskets, etc., said to be suitable for pressures up to 1,000 atmospheres. The feature of the product, which is manufactured and patented by Messrs. Richard Klinger, Ltd., lies in the fact that exceptionally tough asbestos fibre is compressed together with a high-temperature-resisting steel wire mesh into one solid whole, preventing the severest conditions experienced on internal combustion engines and high-pressure steam plant from blowing out a joint made of the material. It has proved satisfactory as cylinder-head gasket jointing on supercharged motor-car engines, on Diesel engines, and as jointing on modern high-pressure steam turbines. It can be fitted as a joint on such places where solid copper or copper and asbestos will give out. Owing to the wire mesh embodied in the jointing, very thin washers are said to be equally resisting to severe conditions.

Regardless of the highly compressed nature of this jointing, it is nevertheless sufficiently elastic to "breathe," and a reliable joint is thus secured under cold or high-temperature conditions.

Inquiries to R. Klinger, Ltd., 120, Southwark Street, S.E.1.



**ROTOR STATISTICS: The bearings which carried the rotor of an Armstrong-Siddeley supercharger unit during type tests recently. The bearings ran for 140 hours, and it is calculated that during this period the rotor made 142,800,000 revolutions. A point on the circumference of the rotor travelled 62,800 miles, and its maximun velocity was 817 m.p.h., or 1,200 ft. per sec., i.e., faster than the speed of sound.**

## INVESTIGATION OF TURF

IT is in the interests of aerodrome managers to know that if they require expert knowledge about the turf on their aerodromes, the Board of Greenkeeping Research will readily assist them. This Board was founded in 1929 by the British Golf Unions for the purpose of conducting research work on the maintenance of turf for golf and other sports, and lately they have had some experience in connection with aerodromes. The subscription terms and the required information can be obtained on communicating to R. B. Dawson, Esq., St. Ives Research Station, Bingley, Yorks.

## A WINNER'S CHOICE

MR. BUCKINGHAM chose National Benzole Mixture and Castrol Oil to help the "Gipsy III" engine of his "Fox Moth" carry him to victory in the Romford-Clacton-Romford Race on September 24.

## R.A.F. JEWELLERY

THE latest publication of Messrs. Gieves, Ltd., the specialists on the needs of airmen, is the Royal Air Force Book of Jewellery, containing attractive illustrations of R.A.F. brooches, links, and a variety of other useful articles, many appropriately finished off in R.A.F. blue and engraved with a raised R.A.F. badge. All the jewellery illustrated in this catalogue can be executed with the badge if required. Squadron brooches are also made to order by Gieves, Ltd., whose address is 21, Old Bond Street, W.1.

## METEOROLOGY

THE questions on meteorology which form the syllabus in the examination for commercial pilots' (Class "B") licences are published in a handbook issued by Commonweal Press, Ltd., 43, Chancery Lane, W.C.2. The answers are also given, although purposely more comprehensive than would be necessary in the examination. All airmen will find this book of value whether they are concerned with Class "B" and 2nd class navigators' licences or not. Although the identity of the author remains anonymous, the student may place reliability in the book as the author is known to the reviewer as an expert on meteorology. The price is 2s. net.

## SHELL IN SOUTH AFRICA

SHELL Motor Spirit and Shell Aero Oil was used by Capt. R. Douglas when he won the 1st South African Air Rally at Cape Town, flying a "Puss Moth."

## SMALL FURNACES

WE have received the latest catalogue of Wild-Barfield Electric Furnaces, Ltd., describing their small electric furnaces for works and laboratory use. It would be useful to works managers who are concerned with the problem of heat-treatment operation, particularly if uniform heating is essential. There is a range of types described and illustrated. All the general-purpose furnaces are suitable for temperatures up to 1,000 deg. C., and unless otherwise specified, they can be operated on alternating or direct current supplies of any standard voltage. A valuable protecting device is the excess temperature cut-out, which more than doubles the life of heating chambers by protecting the windings from the effects of accidental overheating. This cut-out consists of a loop of silver (or gold) wire which fuses at 960 deg. C. (gold 1,050 deg. C.), and automatically cuts off the heating current.

Elecfurn Works, North Road, N.7, is the company's address.

## BALSA WOOD

BALSA WOOD, from which the special plywood of that name is manufactured for use in aircraft construction, is a timber widely grown in S. America, the best coming from Ecuador. The name "Balsa" is derived from the Spanish word spelt the same and meaning "raft." The earliest European intruders into S. America found the Indians using this exceptionally light wood for constructing their rafts. Its growth is extremely rapid, and the best of its kind comes with trees about four years old, the planks obtainable from these being as light as 4 lb. per cu. ft. Some years ago the supply of this timber became the problem of those concerned, and experiments were made in planting, in selected ground, seeds obtained from the wild variety. The growth of this timber was carefully observed and the trees were only cut when they reached maturity. Improvements in the standard of the Balsa timber exported resulted, and to-day the timber received by the Balsa Wood Co., Ltd., Kingsway, W.C.2, is of very high quality. It includes planks 18 ft. × 18 in. × 5 in. thick. A boy can place one of these upon his shoulder without any strain. The average weight of the timber received now is about 7 or 8 lb. per cu. ft.

## ASSURANCE

DETAILS of a staff assurance scheme by which employers and employees co-operate in making provisions for the latter against the "pangs of outrageous misfortune," like the retiring age and illness, are explained in a booklet received from Walter Herriot, Incorporated Insurance Broker, Bush House, Aldwych, W.C.2. Mr. Herriot specialises in the preparation of such schemes for employers.

## PATENTS AND CONSULTATION

MR. CHARLES S. PARSONS, B.Sc., C.P.A., Companion of the Institute of Electrical Engineers, is now released from his partnership engagement with Forrester, Ketley & Co., and will in future be carrying on practice under his own name as a Chartered Patent Agent and Consulting Engineer at Thanet House, 231, Strand, W.C.2. (Telephone, Central 5315.)

## LINKS

THE September issue of "Links," the house organ of Alexander Duckham & Co., Ltd., contains brief but interesting matter, the light but not flippant features revealing the Editor's wisdom in appreciating the danger of talking strictly shop on every page if he seeks to attract outside readers. His "Oilitorial" is an appropriate and therefore excusable juggling with phraseology. The address of the company is Duckham House, 16, Cannon Street, E.C.4.

## "LIFEGUARD" POLISH

WE know that the inventors of new polishes are far too prolific for the needs of each decade, but we can thoroughly recommend "Lifeguard" as a polish for cellulose surfaces. On cellulosed struts and ply-covered fuselages it produces a surface which lasts far longer than does an ordinary polish and, moreover, does not finger mark. It does not contain acids, alkalis or coarse abrasives, and it is equally good for cleaning and polishing window glass and chromium-plated and nickel-plated parts. It is produced by Lewis Berger & Sons, Ltd., Homerton, E.9.

## HENLYS, LTD.

IT is not generally known that, apart from aeroplane hangars and showrooms at Heston Airport, Henlys have motor car showrooms there. These have been in existence for some considerable time now, and have, moreover, proved of assistance to both themselves and aeroplane owners who wished to avail themselves of Henlys' service for their motoring requirements. By arrangement, after perusal of their list of cars in stock—or in the case of any type or make of new car, Henlys will arrange for the particular examples required to be at these showrooms at Heston to await inspection and trial of them by any aeroplane owner on his arrival at the airport.

## ALL ABOUT THE "FOX MOTH"

ALL the information that the prospective aircraft buyer may like to have about the De Havilland "Fox Moth" is contained in a neat and attractive illustrated booklet arranged by Mr. W. E. Thomas, Grand Buildings, W.C.2. The "Fox Moth" has a useful range of utility, namely, as a family machine for owner pilots, as a tourer, for two passengers and luggage, as an ambulance for conveying both patient and nurse, as a survey and photographic aircraft, as a freight and mail carrier, and finally as an air-taxi carrying three passengers and luggage.

A useful page of performance data is also included in this booklet, which supports its text with well chosen and informative illustrations.

## AIRCRAFT COMPONENTS

A CATALOGUE issued by Aircraft Components, Ltd., of Grosvenor Place South, Cheltenham, contains information about the aircraft for which the company have supplied components. The latter include the Dowty shock-absorber struts and Dowty internally sprung wheels and hollow springs. This company specialises in undercarriage equipment, and will be pleased to give price quotations and technical information on request. All parts are supplied with A.I.D. release certificates, the company being an Air Ministry approved firm.

# THE ROYAL AIR FORCE

*London Gazette, September 20, 1932.*

*General Duties Branch*

D. G. Keddie is granted a permanent commission as a Pilot Officer with effect from September 5, and with seny. of September 5, 1931; Lt.-Cdr. H. L. St. J. Fancourt, R.N., is re-attached to the R.A.F. as a Flight Lieutenant with effect from September 12, and with seny. of January 1, 1930; Pilot Officer on probation J. Goodhart is confirmed in rank (September 11); Sqd.-Ldr. A. H. Wann is placed on the half-pay list, Scale A, from August 7 to August 19 inclusive (substituted for notification in the *Gazette* of August 16); Cdr. R. St. A. Malleson, A.F.C., R.N., Flight Lieutenant, R.A.F., ceases to be attached to the R.A.F. on return to Naval duty (September 5); Lt. J. B. Buckley, R.N., Flying Officer, R.A.F., ceases to be attached to the R.A.F. on return to Naval duty (September 13); Flt.-Lt. P. S. Mumford (Captain, R.A.R.O.) is transferred to the Reserve, Class C (September 19); Lt.-Com. D. M. L. Neame, R.N., Flying Officer, R.A.F., relinquishes his temporary commission on return to Naval duty (July 26, 1931) (substituted for notification in the *Gazette* of August 14, 1931); Lt.-Com. E. W. E. Lane, R.N., Flying Officer, R.A.F., relinquishes his temporary commission on return to Naval duty (September 12). The short service commission of Pilot Officer on probation J. A. Sandeman is terminated on cessation of duty (September19).

*Medical Branch*

F/O. G. A. M. Knight, M.B., B.S., is promoted to the rank of Flight Lieutenant, with effect from August 22, and with seny. in that rank of April 27.

### ROYAL AIR FORCE RESERVE
### RESERVE OF AIR FORCE OFFICERS

*General Duties Branch*

B. A. Davy is granted a commn. in Class A as a Flying Officer (August 22); A. J. S. Morris is granted a commn. in Class AA (ii) as a Pilot Officer on probation (September 5); Flt.-Lt. R. E. H. Allen is transferred from Class B to Class C (September 12).

The following Flying Officers relinquish their commissions on completion of service :—K. Maconochie, C. N. A. B. Mumby, L. H. Ross (September 15).

F/O. J. F. Herd relinquishes his commn. on completion of service and is permitted to retain his rank (August 29); the commission of Pilot Officer on probation E. B. Robertson is terminated on cessation of duty (August 26).

## ROYAL AIR FORCE INTELLIGENCE

**Appointments.**—The following appointments in the Royal Air Force are notified :—

*General Duties Branch*

*Squadron Leaders :* C. F. Horsley, M.C., to H.Q., Coastal Area, Lee-on-the-Solent, 9.9.32, for Personnel Staff duties vice Sqdn.-Ldr. A. G. Bond, A.F.C. H. I. T. Beardsworth to Station Flight, Duxford, 13.9.32, for Flying (Flying Instructor) duties. D. S. Earp, D.F.C., to No. 9 (B) Sqdn., Boscombe Down, 19.9.32, for flying duties vice Sqdn.-Ldr. V. R. Scriven.

*Flight Lieutenants :* L. G. Martin to H.Q., Mediterranean, Malta, 1.9.32. S. Upton to The Packing Depot, Sealand, 18.9.32. N. A. Pearce to Station H.Q., Mount Batten, 16.9.32.

*Flying Officers :* J. Y. Humphreys to No. 450 (F.S.R.) Flight, 9.9.32. G. R. Brice to No. 202 (F.B.) Sqdn., Malta, 25.8.32. L. H. Anness, A.F.C., to No. 607 (County of Durham) (B) Sqdn., Usworth, 5.9.32. J. R. Fraser to No. 26 (A.C.) Sqdn., Catterick, 4.9.32. E. A. Jones to No. 5 Flying Training School, Sealand, 15.9.32. R. Jones to No. 26 (A.C.) Sqdn., Catterick, 14.9.32. E. A. Cooke to No. 40 (B) Sqdn., Abingdon, 9.9.32. J. Whitehead to No. 446 (F.S.R.) Flight, 15.9.32.

*Pilot Officers :* P. A. de G. Tettenborn to No. 57 (B) Sqdn., Upper Heyford, 11.9.32. M. F. Calder to No. 70 (B) Sqdn., Hinaidi, Iraq, 29.8.32. D. G. Keddie to Central Flying School, Wittering, 5.9.32, on appointment to a Permanent Commn.

*Acting Pilot Officers :* The following Acting Pilot Officers are posted to No. 2 Flying Training School, Digby, on 27.8.32, for Flying Training :—I. W. Braye, P. D. Carden, R. P. H. Carew, F. M. C. Corelli, H. S. Darley, H. L. Fry, A. F. Hamilton, P. H. Holmes, C. C. House, E. B. King, H. J. F. Le Good, I. J. McGhie, E. W. Owens Thurston, B. O. Prowse, J. G. Rhys-Jones, F. W. Richards, I. A. Scott, A. T. H. Willis and J. W. Young.

*Dental Branch*

*Flying Officer* S. C. Allen to Station H.Q., Boscombe Down, 24.9.32.

## AIR MINISTRY NOTICES

### AIR MINISTRY NOTICE TO AIRMEN. SERIES A

**No. 46 of the year 1932. Examinations for Civil Air Navigators' Licences. (141391/31.)**

Subject to a sufficient number of applications being received, a supplementary examination for 1st Class Air Navigators' Licences will be held in London on Monday, Tuesday, Wednesday and Thursday, 31st October, 1st, 2nd and 3rd November, 1932. An examination for 2nd Class Air Navigators' Licences will also be held on Monday, Tuesday and Wednesday, 31st October, 1st and 2nd November, 1932, at the following centres :—

(i) LONDON.
(ii) HELIOPOLIS (the office of the British Civil Aviation Directorate Representative in Egypt, Heliopolis Aerodrome).
BAGHDAD (Hinaidi Aerodrome).
(iii) SINGAPORE (Seletar Aerodrome).

Application forms, the syllabi and conditions of examination may be obtained on application in writing to (i) the Secretary, Air Ministry (C.A.2), Adastral House, Kingsway, London, W.C.2, (ii) the British Civil Aviation Directorate Representative in Egypt, Heliopolis Aerodrome, Heliopolis, Egypt, or (iii) the Officer Commanding, R.A.F. Headquarters, Far East Command, Singapore, Straits Settlements.

(i) Formal applications for permission to attend these examinations must be made on form C.A.2.c. and, together with the prescribed fees, must have been received at the appropriate address not later than Monday, 3rd October, 1932.

(ii) In no circumstances can late applications be considered.

(iii) Applications for examination in London should be lodged with :—
The Secretary, Air Ministry (C.A.2),
Adastral House, Kingsway, W.C.2.

(iv) Applications for examination in Heliopolis should be lodged with :—
The British Civil Aviation Directorate Representative in Egypt,
Heliopolis Aerodrome, Heliopolis, Egypt.

(v) Applications for examination in Baghdad should be lodged with :—
The Air Officer Commanding, Iraq Command,
Royal Air Force, Air Headquarters, Hinaidi, Iraq.

(vi) Applications for examination in Singapore should be lodged with :—
The Officer Commanding, Far East Command, Royal Air Force,
Headquarters, Singapore, Straits Settlements.

(vii) Candidates should give with their formal applications, full details of any qualifications and experience they already possess.

Before a licence can be issued, candidates must pass the prescribed medical examination, for which special arrangements will be made where necessary.

Copies of the papers set at previous examinations for 2nd Class Air Navigators' Licences may be obtained from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2, or through any bookseller, as follow :—

Papers set at the six examinations held in October 1930, July 1930, March 1930, October 1929, December 1928 and April 1928, bound in one volume, price 2*s.* net, or 2*s* 4*d*. post free.

Papers set at the examination held in March/April 1931, price 6*d*. net, or 8*d*. post free.

Papers set at the examination held in October 1931, price 6*d*. net, or 8*d*. post free.

Papers set at the examination held in March 1932, price 6*d*. net, or 8*d*. post free.

Copies of the papers set at previous examinations for 1st Class Air Navigators' Licences may be obtained free of charge on application to the Secretary, Air Ministry (C.A.4), Adastral House, Kingsway, London, W.C.2.

The attention of candidates is drawn to Notice to Airmen, Series A, No. 38 of the year 1932.

A further examination for Air Navigators' Licences will be held at or about the end of March 1933.

(July 25, 1932.)

### AIR MINISTRY NOTICE TO GROUND ENGINEERS

**No. 39 of the year 1932. Examination of Applicants for Ground Engineers' Licences or Extension to the Scope of Existing Licences. (33611/30.)**

Examination Boards will sit for the purpose of examining applicants for ground engineers' licences at the following places and times :—

(*a*) London, weekly, on each Wednesday in October, November and December.
(*b*) Croydon, on the second Friday in October, November and December.
(*c*) Manchester, on the first Friday in November.
(*d*) Bristol, on the first Friday in October.

Applications for licences should be made on the appropriate form which is obtainable on request, and should be addressed to The Secretary, Air Ministry (C.A.2), Adastral House, Kingsway, London, W.C.2. Applications for extensions to existing licences will also be dealt with at these boards and such applications should be made by letter to the above address, giving particulars of experience in respect of the extension desired, together with the fee of 5*s*. and stating the centre at which the applicant wishes to attend for examination.

Application for examination at the centres named at (*c*) and (*d*) above can only be accepted provided that the application is received 28 days before the dates specified, and provided also that the total number of applications received is within the capacity of the board. Applicants whose applications are not accepted owing to these provisions will be given the opportunity of early examination in London or, alternatively, of being placed on a waiting list for the next board to be held in the place in question.

(August 25, 1932.)

### Small Cabin Aircraft : Need for Caution during Flight under certain Conditions

PILOTS flying small cabin aircraft are warned by G.E.'s Notice No. 41 of the year 1932 of the need for caution when flying in or near clouds, particularly in rough or disturbed weather.

Below and in certain types of clouds, air currents with large vertical velocities exist. In some cases, the vertical velocity over a small localised area amounts to 30 ft. per sec., while during a thunderstorm, or even during the later stages of its development, a vertical velocity of 50 ft. per sec. may be expected.

These dangerous conditions are usually indicated by one or more of the following signs : (1) Unusually squally winds at ground level. (ii) Wind direction between west and north ; (iii) Clouds of a cumulus type, often building up during the day to very considerable heights ; (iv) Rapid decrease of temperatures with height above the ground.

In such circumstances, high speeds should be avoided and, as far as practicable, passengers and other movable load should be secured.

# AIRCRAFT COMPANIES' STOCKS AND SHARES

SINCE these notes were written a month ago there has been a general upward movement in shares of industrial companies, and on balance some substantial advances have been established. Best prices touched have not been maintained, the tendency being for sentiment to fluctuate from day to day with Wall Street markets. Nevertheless, throughout the month steady support has been reported for shares of companies which stand to be among the first to benefit from a revival in trade conditions. Shares of aircraft and allied companies participated in the general tendency, and at the time of writing are moving in favour of holders under the influence of market expectations of an increase in the Imperial Airways dividend. Estimates of the latter range up to 7½ per cent., but not more than 5 per cent. is looked for in many financial circles, as the directors are expected to follow a conservative policy. For the previous year the dividend was lowered to 3 per cent., but in respect of the past year the company's business is believed to have benefited from the lower external value of sterling. Fairey Aviation have shown a further improvement on the month from 15s. to 17s. 3d., on hopes that the dividend will be maintained. The company closes its year this month, and the results do not fall to be announced until December. De Havilland, whose report is also not due until the same month, have not attracted a great deal of business, but gained a few pence on the month to 15s. 6d. D. Napier put on a similar amount to 4s. 3d., in sympathy with the better tendency in aircraft and allied shares, but the 7½ per cent. preference have gone back to 18s. 9d. Rolls-Royce are 4s. up on the month at 42s., having been aided by reports that the company's works are more active. Triplex Safety Glass benefited from the good results for the past year and the statements at the meeting. The price, which may be regarded as carrying the forthcoming 10s. return of capital, has gained 4s. 6d. on the month to 42s. 6d. British Aluminium are higher on the month, despite the absence of an interim dividend. The market was prepared for resources again being conserved, as a similar policy was followed in respect of the interim dividend last year. There has been a good rise of around 6s. in British Oxygen since these notes appeared a month ago. This reflects the view that the company's earning capacity stands to recover rapidly when the engineering and allied industries are doing better. In some quarters there are hopes that interim dividends may be resumed with a small payment. On balance for the month Joseph Lucas gained around 8s. on the possibility that another high rate of dividend will be forthcoming. "Shell" and other leading oil shares were stimulated by the rise in the price of petrol and by market expectations of another increase before long, especially if, as is being suggested, the big oil groups arrive at a satisfactory agreement with Soviet oil interests. Dunlop Rubber remained under the hope that interim preference dividends may be forthcoming and have risen 3s. 6d. on the month to 18s. 10½d.

| Name. | Class. | Nominal Amount of Share. | Last Annual Dividend. | Current Week's Quotation |
|---|---|---|---|---|
| | | £ | % | |
| Anglo-American Oil .. | Deb. | Stk. | 5½ | 101½ |
| Armstrong Siddeley Develop. | Cum. Pref. | £1 | 6½ | 13/9 |
| Birmingham Aluminium Castg. | Ord. | £1 | 5 | 17/6 |
| Booth (James), 1915 .. | Ord. | £1 | 15 | 46/3 |
| Do. do. .. .. | Cum. Pref. | £1 | 7 | 26/3 |
| British Aluminium .. | Ord. | £1 | 5 | 24/4½ |
| Do. do. .. .. | Cum. Pref. | £1 | 6 | 21/3 |
| British Celanese .. | Ord. | 10/– | Nil | 10/– |
| British Oxygen .. | Ord. | £1 | 3 | 20/7½ |
| Do. do. .. .. | Cum. Pref. | £1 | 6½ | 21/3 |
| British Piston Ring .. | Ord. | £1 | 10 | 25/– |
| British Thomson-Houston .. | Cum. Pref. | £1 | 7 | 26/10½ |
| Brown Brothers .. | Ord. | £1 | 10 | 28/9 |
| Do. do. .. .. | Cum. Pref. | £1 | 7½ | 26/3 |
| Dick (W. B.) .. .. | Cum. Pref. | £10 | 5 | 120/– |
| De Havilland Aircraft .. | Ord. | £1 | 5 | 15/6 |
| Dunlop Rubber .. | Ord. | c | Nil | 18/10½ |
| Do. do. .. .. | "C" Cum. Pref. | 16/– | 10 | 19/– |
| En-Tout-Cas (Syston) .. | Def. Ord. | 1/– | Nil | –/9 |
| Do. do. .. | Ptg. Pfd. Ord. | 5/– | 8 | 2/6 |
| Fairey Aviation .. | Ord. | 10/– | 10* | 17/3 |
| Do. do. .. .. | 1st Mt. Deb. | Stk. | 8 | 109 |
| Firth (T.) & John Brown .. | Cum. Pref. | £1 | 6D | 4/6 |
| Do. do. .. .. | Cum. Pref. | £1 | 5*D | 3/6 |
| Ford Motor (England) .. | Ord. | £1 | Nil. | 25/6 |
| Fox (Samuel) .. .. | Mt. Ptual. Deb. | Stk. | 5 | 82½ |
| Goodyear Tyre and Rubber .. | Deb. | Stk. | 6½ | 106 |
| Handley Page .. .. | Ptg. Pref. | 8/– | 12½ | 9/4½ |
| Hoffmann Manufacturing .. | Ord. | £1 | Nil | 15/6 |
| Do. do. .. | Cum. Pref. | £1 | 7½ | 18/9 |
| Imperial Airways .. .. | Ord. | £1 | 3 | 23/6 |
| Kayser, Ellison .. .. | Ord. | £5 | Nil | 55/– |
| Do. do. .. .. | Cum. Pref. | £5 | 6 | 72/6 |
| Lucas (Joseph) .. .. | Ord. | £1 | 20 | 69/– |
| Napier (D.), & Son .. .. | Ord. | 5/– | Nil | 4/3 |
| Do. do. .. .. | Cum. Pref. | £1 | 7½ | 18/9 |
| Do. do. .. .. | Pref. | £1 | 8 | 12/6 |
| National Flying Services .. | Ord. | 2/– | Nil | –/4½ |
| Petters .. .. .. | Ord. | £1 | Nil | 15/– |
| Do. .. .. .. | Cum. Pref. | £1 | 7½ | 13/9 |
| Roe (A. V.), (Cont. by Armstrong-Siddeley Devel., *q.v.*) | Ord. | £1 | — | — |
| Rolls-Royce .. .. .. | Ord. | £1 | 10 | 42/– |
| Smith (S.) & Sons (M.A.) .. | Def. Ord. | 1/– | Nil | –/9 |
| Do. do. .. .. | Pt. Pfd. Ord. | £1 | 7 | 14/4½ |
| Do. do. .. .. | Cum. Pref. | £1 | 7½ | 17/6 |
| Serck Radiators .. .. | Ord. | £1 | 15 | 32/– |
| "Shell Transport & Trading .. | Ord. | £1 | 7½* | 53/9 |
| Do. do. .. .. | Cum. Pref. | £10 | 5 | £11¼ |
| Triplex Safety Glass .. .. | Ord. | £1 | 10 | 42/6xd |
| Vickers .. .. .. .. | Ord. | 6/8 | 5 | 7/3 |
| Do. .. .. .. | Cum. Pref. | £1 | 5* | 18/- |
| Vickers Aviation (Cont. by Vickers, *q.v.*) .. .. | — | — | — | — |
| Westland Aircraft (Branch of Petters, *q.v.*) .. .. .. | — | — | — | — |

*Dividend paid tax free. c £1 unit of stock. D Last xd. March 1931.

### A.S.T. Course for Commercial Pilots

OWING to the large number of applications received by Air Service Training, Ltd., from candidates desirous of taking the three years' course for commercial pilots, it has been found necessary to run this course by terms. In future, pupils for this course will only be accepted in September and February of each year. At the termination of their training pupils should be in possession of the following qualifications:—"A" and "B" pilots' licences; blind-flying certificate; 2nd-class navigators' certificate; Air Ministry W/T air operators' certificate; "A" and "C" ground engineers' licences; "X" ground engineers' licences for parachutes and compasses.

## PUBLICATIONS RECEIVED

*Aeronautical Research Committee Reports and Memoranda:* No. 1463. *Acceleration of Aeroplanes in Vertical Air Currents.* By H. R. Fisher. March, 1932. Price 1*s.* net. No. 1456. *Relation between Ground Contours, Atmospheric Turbulence, Wind Speed and Direction.* By W. R. Morgans. December, 1931. Price 2*s.* 3*d.* net. No. 1464. *Wind Tunnel Tests of Recommendations for Prevention of Wing Flutter.* By B. Lockspeiser and C. Callen. February, 1932. Price 1*s.* 9*d.* net. No. 1469. *Induced Flow through a Partially Choked Pipe.* By H. Glauert, D. M. Hirst and A. S. Hartshorn. March, 1932. Price 1*s.* net. London: H.M. Stationery Office, W.C.2.

*The Journal of the Royal Air Force College.* Vol. XII. No. 2. Autumn, 1932. The Royal Air Force College, Cranwell, Lincolnshire.

*Annual Report by the Director of the Meteorological Office for the Year ended March* 31, 1932. M.O. 348. London: H.M. Stationery Office, W.C.2. Price 1*s.* net.

*Regulations for the Royal Air Force Reserve.* Air Publication 938. London: H.M. Stationery Office, W.C.2. Price 2*s.* net.

*Patents, Trade Marks and Designs: Their Commercial Aspect and Development.* By C. W. Thomas. The Nutshell Series Vol. I. London: Ocean Publishing Co. Price 4*s.* 6*d.* net.

## NEW COMPANIES REGISTERED

AIRCRAFT COMPONENTS, LTD, Grosvenor Studios, Grosvenor Place South, Cheltenham.—Capital £1,000 in £1 shares. Acquiring the business of Aircraft Components now carried on by G. H. Dowty at Grosvenor Studios, Cheltenham, dealers in and manufacturers of aeroplanes, balloons, airships and flying machines of all kinds, etc. Directors: G. H. Dowty, Mrs. Edith Dowty, both of 17, Lansdown Crescent, Cheltenham.

GOODE'S OFFICERS' STORES, LTD., 4, Wickham Street, Portsmouth.—Capital £1,000 in £1 shares. Naval, military and air force outfitters, manufacturers, etc., and agents for civilian clothing. Directors: Mrs. Cecilia J. Goode, E. Goode, S. Goode, H. Goode.

## AERONAUTICAL PATENT SPECIFICATIONS

***Abbreviations:*** **Cyl. = cylinder; i.c. = internal combustion; m. = motors.**

**(The numbers in brackets are those under which the Specification will be printed and abridged, etc.)**

### APPLIED FOR IN 1931

*Published September* 29, 1932

16,385. T. M. MACCASKIE. Aircraft. (379,747.)

17,093. ECLIPSE AVIATION CORPORATION. Starter-mechanism for internal-combustion engines. (379,778.)

17,300. J. DE LA CIERVA. Aircraft with freely rotative wings. (379,782.)

17,302. J. DE LA CIERVA. Blade construction for aircraft-sustaining rotors. (379,782.)

18,057. J. DE LA CIERVA. Aircraft having freely rotative sustaining-means. (379,792.)

19,193. CHANCE BROS. & Co., LTD., and J. H. ABBINK-SPAINK. Starting of Diesel and like engines. (379,805.)

20,656. AKTIESELSKABET DANSK REKYL-RIFFEL SYNDIKAT. Sight device for machine-guns and the like for use against movable targets in the air. (379,815.)

33,919. H. JUNKERS. Metal screw-propellers. (379,933.)